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CONTENTS.

Editorial 593
Arrangements for the National Electric Light Convention..... 596
Blending Steam and Trolley Service 596
The Commercial Future of Wireless Telegraphy..... 596
Utilization of Electricity in Coast Defense..... 597
Right of Appeal from Interlocutory Decrees..... 597
Electrical Club of New York..... 598
Another Bidder for a New Subway in New York City..... 598
Alternating-Current Railway Systems..... 598
Support for Osmium Filaments..... 599
Current News and Notes 599
The Houston, Tex., Lighting and Power Company..... 603
The Heating Effect of the Electric Spark. By Henry A. Perkins.... 608
Circle Diagram of Compensated Series Single-Phase Motor. By E. C. Stone 610
Iron Losses in Single-Phase Commutator Motors. By Prof. Dr. F. Niethammer 612
International Conference on Electrical Units..... 614
LETTER TO THE EDITORS:
Efficiency of Lighting Balancers. By B. F. Jakobsen..... 616
Digest of Current Electrical Literature..... 617
Book Review 620
Single-Phase Equipment for the Central Illinois..... 620
Dayton Fans; The Wireless Lamp Cluster; Tuerk Alternating Current Ceiling Fans; Emerson Fans; Eck Oscillating Fan; Western Electric Universal Fan Motor; Westinghouse 1906 Electric Fans; Sprague Fans; Pillsbury Alternating-Current Ceiling Fan; Peerless Direct-Current Fans; Star Fans; Ventilating Fans; Bates "Universal" Fan; Kenco Battery Fan; Jandus Fans; Diehl Fans; Robbins & Myers 1906 Fans; Fidelity Direct-Current Ceiling Fan; Beaver Battery Fan; Fort Wayne "Wood" Fan Motors; General Electric Fan Motors for 1906; Sterling Fans; Colonial Fans; Kendrick & Davis Fan.....621-630
Industrial and Commercial Notes..... 631
General News 634
Weekly Record of Electrical Patents..... 645

THE FAN MOTOR.

The fan motor is now as staple a part of the electrical industry as insulated wire or the incandescent lamp, but is still susceptible of improvement periodically, so that some variation in style or construction may be expected from season to season. Of such changes in this mechanism, for the year 1906, a general view is presented in our pages this week; and it is encouraging to note how many possibilities of perfection are still recognized to exist in this useful little adjunct of the light and power circuit. For several years past a large number of fan motors have been turned out, until hundreds and hundreds of thousands are to be found in daily use through the summer months. A yearly production worth, say, $1,500,000 would represent not less than 150,000 to 200,000 a year, at net prices, and the annual value seems to be somewhere around those figures. We think the product might easily be increased in bulk and amount, and that there is probably not a single central station system that has its fan motor business taken care of or developed up to the "saturation point." Hardly any one who reads this cannot mention some home or office or factory that he visits between May and October where fans could not be installed—and where perhaps the suggestion to put them in has never been made by the central station interested.

ELECTROPLATING.

The article elsewhere by Mr. A. J. Tizley illustrates the prevailing lack of knowledge of the technical principles of electroplating by those engaged in the art. The conservatism which is also a characteristic of this industry is illustrated in an old established electroplating plant recently visited, where a battery of Smee cells is still used, the reason being that this has been the practice since the works were started and it has always proven satisfactory. According to the recent Census, there are more than 1,300 electroplating plants in this country, and the annual loss of money through the conditions above indicated must aggregate a pretty sum. Electroplating appears to be generally carried on by rule of the thumb, and it is only recently that the importance of exact measurements in the practice of this art has come to be understood, and ammeters, voltmeters and precision balances introduced. Saving of power, however, is only one item, and probably less important than others relating to the purely chemical side of the art. With respect to solutions, the practice in the past appears to have been to add a spoonful of some "dope" if the deposit did not look good, and then if the appearance did not improve to add a pinch of some other "dope." Of course, none knew what the final solution really consisted of. It is not only necessary for the electroplater to measure the volts and amperes and regulate them according to the specific requirements of a given work, but he should also know the exact composition of the solutions and anodes, and should weigh with precision every material he adds to the bath. Only in this way can he properly control the operations.

But the practical electroplater is not the only one at fault, for those who should guide him have too largely devoted their

attention to the more interesting—because relatively simple—phenomena of "indefinitely dilute" solutions, instead of to the actual phenomena of the electroplating bath. Fortunately a reaction is here also in evidence, though at present there is a surprising disagreement among electrochemical authorities when it comes to the consideration of the scientific side of electroplating. Taking the fact expressed in the language of the electroplater that the metallic coating will adhere to the base metal only if the two metals are such that they will "stick" together, Prof. Kahlenberg expresses this in the statement that they must alloy. Prof. Burgess thinks that the "alloying" phenomenon is not universal, and that in many cases there is "direct cohesion." However we may express this requirement, we know that if we want to plate nickel on copper, which metals alloy, there is no difficulty; on the other hand, if we want to plate nickel on lead, the lead is first plated with copper and then the copper with nickel, as the latter metal, which does not alloy with lead, would not stick if directly plated thereon. Burgess and Hambuechen's method of plating aluminum articles with gold is a further illustration, the aluminum being first plated with zinc, then with copper and finally with gold.

Another general principle that should not be lost sight of is that the electric current passing necessarily changes the electrolyte, at least in concentration. In copper plating the cathodic effect of the current is to remove copper ions from the layer of solution in intimate contact with the cathode. If a low cathodic current density is used, there is time for diffusion to bring fresh metallic copper ions into this critical change; but as the current density is increased the less will be the effects of diffusion and the more the impoverishment of the layer. Hence the well-known deleterious effects of high current density, sometimes expressed by electroplaters as the "burning effect" of the current. When the cause is understood the remedy is self-evident, it being necessary to bring continually fresh metal ions into the layer next to the cathode, which may be done by stirring the electrolyte, by the use of revolving electrodes, by heating, etc. It is most sincerely to be hoped that in the future more than in the past men of theory and practical electroplaters will work together in a co-operative spirit. The present very unsatisfactory condition of the art would, under this condition, soon be changed to the benefit of the practical man, while the electrochemist would have his knowledge of many interesting electrolytic actions largely clarified and even extended.

Fluxmeters for the Measurement of Electromagnetic Fields.

A very interesting and novel type of instrument has recently been taken up by the Cambridge Scientific Instrument Company of England. It is called the Grassot fluxmeter. It consists essentially of a D'Arsonval galvanometer in which the horizontal forces on the coil are made so small as to be insignificant in view of the powerful electromagnetic damping of the moving system. An exploring coil is used with the instrument just as in the ordinary measurement of a magnetic field with a ballistic galvanometer. In the latter case, as is well known, the period of time during which the exploration of the field is effected by the coil must be short compared with the period of oscillation of the galvanometer needle. If the needle's period be, say, thirty seconds, the motion of the exploring coil through the magnetic field ought to be completed in about three seconds, in order that the first swing of the galvanometer needle may measure the flux cut by the exploring coil. But the period of the fluxmeter coil is made enormously great by the use of a delicate suspension fibre, so that the motion of the exploring coil can be made in the most leisurely way. The deflection of the coil is also semi-permanent, instead of being a mere evanescent swing; so that the coil assumes a new position, and its displacement measures the maxwells or total flux, that has been introduced into the exploring coil. An advantage of the instrument is that it reads off maxwells directly on its scale for an exploring coil of suitable dimensions, and enables the intensity of the field in gausses to be very readily deduced. A galvanometer needle that has to be pushed back to zero, and that stays where it is put by the maxwells, is a curiosity.

Heat from Sparking Coils.

We are glad to publish a brief report of a research on this subject by Prof. Perkins. Some time since we raised the question as to the conditions of efficiency in the ignition of the charge in gasoline engines, and this paper is the first fruit of the discussion. It is directed primarily to the heat actually developed by a spark and not to the relation of this quantity to the conditions of ignition, serving therefore as a useful reconnoisance upon which to base further investigations. The measurement of the fluctuating currents and voltages involved in the operation of an induction coil is not altogether an easy matter in general, but for the limits of precision attainable in this class of investigation, Prof. Perkins' method is both simple and sufficiently precise. It could easily have been converted into a null method had occasion required further refinements. The measurement of the primary watts is on the whole the most troublesome feature of the experiment. The voltameter method gives, however, at least an approximate idea of the magnitude in question, and as might be expected the efficiencies found for the heat of the spark were low. The maximum figure was 42 per cent, and we are disposed to think that even this is higher than a more rigorous investigation would have found, and very far in excess of the efficiencies generally realized in automobile spark coils in use. This particular value was obtained with a long spark, about 0.225 inch, for which the relative efficiency of the secondary coil may be taken as much higher than for a spark across a short gap of lower virtual resistance.

The relation between different lengths of spark is an interesting and somewhat complicated one. As the spark is lengthened, both the total output of energy in the secondary coil and its distribution as between exterior and spark and interior resistance, in all its items, change. The change due to frequency can hardly be regarded as of any further significance than as a natural result of the change in the relations existing between the electrical constants of the secondary. Capacity cuts considerable figure in these high voltage spark coils and cannot be left out of account. No very simple relations between frequency, spark-length, input and efficiency can therefore be expected. For the purpose in hand it is sufficient to realize that the efficiencies are all low, in practice probably all under 20 to 25 per cent and generally much under. This point cleared up, one can more intelligently go about improving the efficiency. Now we do not quite agree that the best way to do this is to lengthen the spark-gap unless it is shown that with a long gap a given input in energy will produce a higher spark tempera-

ture than with a short gap, the coil being in each case designed for maximum efficiency. Speaking broadly, the temperature depends upon the concentration of energy, and Mr. Perkins' long gap of 0.225 in. developed only a little more than three times the heat concentrated in the shortest gap of 0.025 inch. So if the temperature at the spark is the important thing there is a reason to believe that a short gap will meet the requirement of a given temperature with less expenditure of primary energy than in the case of the long gap. A properly proportioned condenser would undoubtedly still further enable one to concentrate energy in a short spark, and with a suitable designed secondary this could probably be done with fair efficiency.

The upshot of the matter is that the final solution of the problem in hand may best be reached by working backwards, i. e., from the result of the explosion to the method of ignition. Prof. Perkins' results are most useful data to serve as guide posts on the way, and we hope he will follow up the line already laid out. The practical question to be settled is how best to obtain efficient sparking in an engine. The first point to be determined is the relation of spark length and intensity to the explosion produced. In other words, what is the maximum energy required to give first class ignition, and is it better to have this energy so distributed as to give a long spark or a short one? There is no doubt that a very weak spark will fire the explosive mixture, but will it do it as effectively as a stronger or a longer one? Probably not, and indeed there is reason to think that ignition would be more effective could it take place over a considerable area. Granted this, what if any is the difference produced by lengthening the spark and by shortening it, by using condensers, or omitting them? And beyond this, what is the comparative effect of sparks from an induction coil and the flash from a wiping contact? There is thus plenty of work ahead, and room for many workers. The end is to find out the very best way of arranging the ignition of the engine, which is an extremely important matter. If the ignition can be secured from simple dry batteries at two or three times the efficiency now usual, a long step will have been made in advance. If, on the other hand, dynamo ignition is practically needful on account of the input demanded, then the sooner the conditions to be met are put on record the better. In any case, sparking apparatus, source of energy, and spark plugs must be co-ordinated as a whole in order to get first-class results. It may be taken for granted, for instance, that the coil best suited, with a given plug, for use with dry batteries, will not be the best to use with storage batteries or dynamo. There are some thousands of automobilists daily putting up prayers or imprecations *in re* ignition, and the best that can be offered them at present is the choice between one unknown quantity and another. With the general use of four and six-cylinder engines the demands on the source of power have been greatly increased and improvements are necessary.

CIRCLE DIAGRAM OF THE COMPENSATED SERIES SINGLE-PHASE MOTOR.

Judging the motor solely by the theory connected with its operating characteristics, one of the simplest machines of the alternating-current type which has yet been produced is the compensated series motor. If one neglects the modifying effects of the short-circuit by the brush of a coil in which there exists an active e.m.f., and assumes that the cores are devoid of hysteresis, then the circuits of the motor may be treated as equivalent to a constant inductive reactance in series with which is a resistance, the value of which varies with the speed. This fact will be appreciated at once when it is remembered that the field flux is in time phase with the current through the machine; that the e.m.f. which is counter-generated in the armature by the cutting of the field flux by the armature conductors under speed conditions, is in time phase with this flux and in phase opposition to the armature current, and therefore acts as an apparent resistance in the armature circuit. Moreover, this speed-generated e.m.f. is proportional directly to the product of the speed and the current taken by the motor, and hence the apparent resistance varies directly with the speed.

The impedance diagram of such an ideal motor possesses two vectors in quadrature; one represents the constant reactance of the field and armature circuits, and the other indicates the apparent resistance of the circuits. The tangent of the angle of lag of the current behind the e.m.f. of the circuit is the ratio of the former to the latter vector. These statements apply to either the compensated or the uncompensated series motor. In the latter machine the ratio of the torque to the square of the current is the same as that in the former, but the operating power factor of the compensated motor is considerably better than that of the uncompensated machine on account of the smaller reactance of its circuits, and the torque varies more rapidly with a change in the speed when subjected to a constant impressed e.m.f. If in series with a constant reactance there be inserted a variable resistance and the combination be subjected to a constant impressed e.m.f., the current which passes through the circuit will, as is well known, have a value and phase position with reference to the e.m.f. such that it may be represented by a vector whose extremity describes the arc of a circle.

It is upon this latter fact that the construction of the circle diagram of the compensated series single-phase motor depends, as is outlined in an article by Mr. E. C. Stone, on page 610 of this issue. In the formation of the diagram the author has included the modifying effects which were neglected in the outline given above, and hence the results which are obtained are more nearly accurate than the simpler diagram would show. The assumption is made that the speed-generated e.m.f. is out of phase with the line current by an angle which depends upon the core loss and upon the losses in the short-circuited armature coil; so that the increase in the impedance of the armature under speed conditions is not wholly equivalent to the addition of resistance. Since the phase angle between the speed e.m.f. and the line current is practically constant, however, the increase in the apparent impedance is proportional to the speed, and the speed may be represented on the diagram by taking account of this fact. The input to the motor varies directly with that component of the current which is in phase with the e.m.f., while the output depends upon the losses. The author assumes that the torque varies with the square of the current, and that the output is the product of the torque and the speed. A diagram based on these assumptions could correctly represent the facts if the losses varied directly with the square of the current. The torque indicated in the diagram represents the turning moment on the armature structure, neglecting the friction and certain core losses, and, in respect to this torque, the diagram is sufficiently accurate for all practical purposes.

Arrangements for the National Electric Light Convention.

As chairman of the committee on arrangements, Mr. Arthur Williams has just issued convention circular No. 1 as to the arrangements for the convention of the National Electric Light Association, at Atlantic City, N. J., June 5, 6, 7 and 8. It is stated that no single hotel will be made headquarters, but that the association has leased Young's Pier for the week and will there hold its meetings, the secretary having his office for registration, badges and general information at the land end of the pier. The meetings will be held in the small auditorium at the middle of the pier, and the trade exhibition of apparatus will be made in the large room at the end of the pier. There will also be an exhibit of the material and methods employed for advertising purposes by central station companies. The trade exhibition space available will be over 10,000 sq. ft., and a charge not exceeding 20 cents per foot will be made for the entire week, inclusive of everything except the booth erection and any special lighting. Plans of the pier are now being distributed to the associate membership. The front of the pier with a thousand comfortable chairs is available as a music hall and sun parlor.

Special rates have been obtained from 35 hotels, of which 13 are on the ocean front. The inclusive rates for one person, American plan, range from $2 to $4 daily, without bath, and $3 to $6 daily, with bath; for two persons, from $4 to $8, without bath, and from $6 to $10, or slightly higher, with bath.

It is expected that the exhibit will include all the new and striking developments in light and power, and many important reservations of space have already been made. Some of the papers will deal with such developments. The entertainment features also will not be overlooked, but will include a reception at the new Marlborough-Blenheim on June 5, a convention banquet and a whole day excursion for the ladies to Philadelphia, with lunch at the Bellevue-Stratford. It is hoped to have in operation part of the new electrified railroad system between Philadelphia and Atlantic City.

Blending Steam and Trolley Service.

President C. S. Mellen, of the New York, New Haven & Hartford Railroad, has outlined this week his plans for a very interesting and comprehensive blending of the steam and trolley services of that great system. In a speech before the Get Together Club at Hartford Mr. Mellen said, in explanation of the scheme: "We would like to make the experiment on a large scale to determine whether the two systems of traction—steam and electric—may not be worked in common, each supplementing the other, and we would like to electrify our steam tracks between here and Waterbury, and on the Central New England Railway between here, New Hartford and Springfield, and on the east side between here and Rockville, Melrose and Springfield, and upon the Valley line between here and Middletown.

"Instead of running to and from our stations through our yards, with all the switching and delays incident thereto, we want to connect at convenient points with the street railway tracks, and for interurban service make a circuit of the principal streets, collecting and delivering suburban shoppers at the store doors, and we believe both the city and the railroad will be greatly the gainers thereby.

"No city on our lines is so favorably situated as is Hartford for the development of this idea." In order to carry it out Mr. Mellen explained that it would be necessary to substitute T-rails for the usual grooved trolley tracks. "Now, what we want," he continued, "is that you shall permit us to use on the streets where this suburban service will naturally go, the T-rails we use in other cities, New Haven, for instance, and, waiving none of your rights under your contracts, see how it will work, ascertain if the objections are real or imaginary, and if you find there are more objections than advantages after a two-years' trial, we will take up the T-rails, restore the grooved rails and go back to the old order of things.

"I am not afraid of your decision—I will trust you, and if you are afraid to trust me, I will secure the performance of my part of the contract by a good and sufficient bond to your satisfaction. Let me suggest right here that I am advised the contract requiring the use of the grooved rail is not binding in law, but I have none the less required its observance on the part of our company, and shall continue to until we can agree amicably upon its modification.

"I shall be most seriously disappointed if you force me to go elsewhere to try the experiment. The proposition is knocking at your doors—such an opportunity as no other city has to-day."

The Commercial Future of Wireless Telegraphy.

In a recent address before the Beacon Society of Boston Mr. John Stone Stone considered at length the commercial future of wireless telegraphy. Before entering on the main subject of his address he noted some recent important improvements in details. One of these is a means devised by his principal assistant, Mr. Sewell Cabot, whereby the receiving operator in wireless telegraphy can "break in" just as he does in wire telegraphy, and correct any error or ask any question of the transmitting operator that he pleases. At first it was only possible in wireless telegraphy to send about 12 words a minute with any precision whatever, while at present it is possible to send and receive as fast as on a wire line, a speed of about 40 words a minute having been attained. The invention of Mr. Cabot is of great commercial importance, for it obviates repetition to a very great extent, and one may almost say that by means of this invention twice the amount of matter can be transmitted in a given time than would otherwise be possible. In referring to the transmitting and receiving range of wireless telegraphy, he stated that at the Stone station at Portsmouth Navy Yard the dry dock *Dewey* was communicated with from a distance of 1,800 miles.

Mr. Stone said that the future of wireless telegraphy depended upon the solution of the problem of selectivity—a problem which he considered had been solved by his system. He did not believe that the wireless telegraph is going to have its greatest field in competing with transatlantic cables. The great field for a selective system of wireless telegraphy is that where the most people live and where most people wish to communicate, and that place is right on land. The opinion expressed by Marconi and Edison that the field of wireless telegraphy is in the transmission of messages over water was probably due to the fact that they spoke and wrote at a time when it was believed the matter of interference between wireless stations could not be overcome. No considerable competition would, he believed, arise between wire lines and wireless telegraph interests, but rather one will help the other. He drew a distinction between the trunk line service of wireless telegraph companies and the lines, enormously in the majority, which feed this service. The maintenance of the latter costs from 30 to 33 per cent per annum, and they do not yield enough business to pay for this maintenance, money being lost on every message practically that goes over one of the subsidiary lines. The trunk lines, however, are extremely profitable, and more than make up the deficiency. There is a great future for wireless in supplanting these feeders to telegraphic trunk lines—in doing the service now done by one and two-wire lines, and even up to the 10-wire lines. In this there would be a very handsome profit, not a mere manufacturer's profit, but a profit on the patents involved as well as on the apparatus. The selective system of wireless telegraphy will not, however, remain long on a par with wire lines in the matter of operation, but will later open up fields of its own in which wire telegraphy cannot compete because of the excessive cost of pole lines and their maintenance. As an example of new applications, Mr. Stone stated that within the next year it will be possible for a ship more than 100 miles away from the coast to obtain exactly the bearing of any light on the coast within 150 or 250 miles of the vessel; and not only of one light, but of two or more, and thereby be enabled to determine exactly her position.

Utilization of Electricity in Coast Defense.

The report of the National Coast Defense Board recently submitted to Congress by the President contains the interesting and significant statement that "Electricity has become of vital importance to an efficient system of gun defense." The total estimates of the National Coast Defense Board for the completion of the defense of the United States and Insular possessions amount to seventy-four million dollars, and of this sum twenty-seven million dollars is the estimate for apparatus and equipment more or less dependent upon electricity, divided as follows: Power plants, $6,250,000; submarine mine material, $5,650,000; searchlights, $3,486,000, and fire control apparatus, $11,793,000. The estimate for power plants includes the necessary buildings, but aside from this the balance is for electrical apparatus; the $5,650,000 for submarine mine material is largely made up of cable and kindred appliances. Searchlights are entirely an electrical output, and the fire control apparatus includes cable for base lines, lines of information, telephones, and so on.

The committee of the National Coast Defense Board having in charge this question, made the following recommendations:

1. That the electrical power for fortification and defense purposes be furnished by an adequate steam-driven, direct-current producing central power plant, all machinery to conform in type to approved commercial standards.

2. That each battery, or group of batteries, depending upon local conditions, be equipped with direct-current generators, gas or oil-engine driven, installed as a reserve to the central plant.

3. That searchlights, except such as are in close proximity to the central plant, be provided with and operated by self-contained units.

4. That the torpedo casemates be equipped as heretofore with independent power for submarine mine purposes, as an integral part of the submarine mine defense.

5. That when alternating currents are essential, they should be obtained, if practicable, from direct current by means of a suitable converter; or, if more economical, by a separate alternating unit.

6. That the current from the fortification central plants, when not needed for fortification service, may be used for garrison purposes when such distribution does not require too large an increase in the size and number of units.

7. That if garrison service requires alternating current, this should be supplied by the central plant, either through a suitable converter or from alternating-current units specially installed for the purpose in the central station; such increase, however, and all additional cost due to post lighting being a charge against the proper appropriation.

8. That uniformity of types and accessories is desirable.

9. That all electrical power plants for the use of fortifications shall be operated by the artillery.

The decision to employ the direct current was only reached after extended discussion and consideration of many of the peculiar needs of fortification service, as was the recommendation for a central power plant. This central plant will be protected as well as possible from the enemy's fire, but the reserve plants in each battery are provided in case a stray shot should put either the central plant or its communicating cables out of commission. All cables are either subterranean or submarine to protect them as far as may be from accidental injury. The recommendation that all power plants for use of fortifications shall be operated by the artillery means that they will be operated by the enlisted personnel, civilians not being employed therein.

The system of fire control and direction depends largely upon electrical communication, and the Board lays considerable emphasis on the adopted system as adding largely to the effectiveness of the armament; in fact, the statement is made that much of the reduction from the number of guns heretofore considered necessary is due to the advantages of an efficient fire control system.

At each end of a base line, about 2,000 yards long, is placed a powerful telescope—a vertical base range finder, as a matter of fact, for use in emergencies. Electrically-connected clocks at regular intervals sound a bell in each base-end station, when an observation of the angle of the target is made and transmitted by telephone from the secondary to the primary station where the information is plotted and the range and direction of the target from the gun are determined. This information is then corrected for the various ballistic incidents affecting the flight of the projectile, such as temperature, humidity, wind and so on, and the corrected data are sent to the gun. The rapidity with which this is done is remarkable, as observations are made every twenty seconds and the gunner is so often informed of the exact range, so that the gun is kept constantly trained in such position that the projectile will reach a given spot at the same instant as the target. The flight of the projectile varies from 15 to 50 seconds, depending on the range and gun, so that it may be seen that something more is necessary than merely aiming the gun at the target, for the speed of modern war vessels would carry them beyond the danger zone while the projectile was in flight if this were done.

Some idea of the magnitude of the installation for range finding and fire control may be had from the fact that in one of the fortifications near New York City there is to be installed 26,000 ft. of lead cable, 30,000 conductor-ft. inside wire, 262,500 conductor-ft. (about 50 miles) of submarine cable, and 810,000 conductor-ft. (153 miles) of subterranean cable.

As submarine cables enter so largely in the system of range finding and fire control, the proper installation and maintenance of these cables require special appliances and boats, and the Board recommends the purchase of seven such boats, to be stationed at various harbors about the coast. Much has also been learned about the use of searchlights during the various combined army and navy manœuvres.

Right of Appeal from Interlocutory Decrees.

An interesting opinion was handed down by the United States Supreme Court on the 19th inst. in the case of National Enameling & Stamping Company vs. New England Enameling Company, and in the case of Automatic Switch Company vs. Cutler-Hammer Manufacturing Company, which settled a somewhat uncertain point of practice in patent cases, affecting the rights of the different parties to appeal from interlocutory orders or decrees. It is generally recognized that either aggrieved party, or both aggrieved parties, may appeal from a final decree of one of the United States Circuit Courts to the Court of Appeals of the same circuit. It is also recognized that an appeal may be taken by the aggrieved party from an interlocutory decree granting an injunction or appointing a receiver. The question as to whether or not the party in whose favor an injunction is granted by an interlocutory decree, may appeal, on some other point, from such decree, has been involved in some doubt, and this is the question which was settled by the Supreme Court in its opinion. The statute giving the right of appeal from interlocutory decrees is to the effect that such an appeal may be taken when the decree grants an injunction or appoints a receiver. It is silent, however, as to which party has the right to this appeal.

In one of the two above cases it was held in the Circuit Court that three of the claims of the patent sued upon were invalid, that four were valid but were not infringed by the defendant, that five of said claims were valid and infringed, and that as to said five claims, an injunction should issue. The question of damages sustained by the complainant was referred to a master. A final decree could not be entered in the case until the master's report had been made and approved, but an interlocutory decree was entered granting an injunction against the defendant. From this latter decree there was no question as to the defandant's right to appeal, but the complainant also claimed the right to appeal from the finding of the court that three of his claims were invalid and four were not infringed. The Court of Appeals dismissed the complainant's appeal and the matter was then taken to the Supreme Court on mandamus proceedings to have the complainant's appeal reinstated and heard by the Court of Appeals. The argument was made by the complainant that as the interlocutory decree of the Circuit Court granted an injunction, either

party had the right to appeal. The mandamus was refused by the Supreme Court, however, on the ground that the complainant could appeal only from a final decree. This settled the heretofore doubtful point as to the right of either party to appeal from an interlocutory decree which granted an injunction.

Electrical Club of New York.

The Electrical Club of New York has been organized as a down-town luncheon club, and in about two weeks will occupy quarters now being fitted up at 16 Park Place. A large space has been secured on the third floor of the handsome modern office building at this address, and about $4,000 are being expended in fitting it up for the purposes of the club. There will be a large dining-room, a small dining-room, a billiard room and a lounging-room. An arrangement has been made for catering service with Kalil's restaurant, which is one of the best in New York City, and occupies all of the ground floor of the building, together with the basement, which is also very handsomely fitted up as a rathskeller. This arrangement insures an extremely satisfactory bill of fare and table service. One hundred and ten members have already been enrolled and it is expected that the club will be opened with a membership of 150. The present enrollment is well distributed among manufacturers, contractors, jobbers and electric lighting and telephone men. The initiation fee for resident members is $30 and for non-resident members $25, the annual dues being $25 and $15, respectively. Following is a list of the board of managers: G. J. P. Hall, president; H. L. Shippy, vice-president; R. B. Corey, secretary; C. P. Scott, treasurer; Messrs. E. B. Latham, H. T. Johnson, C. I. Hills, C. W. Price and E. F. Keefer.

Another Bidder for a New Subway in New York City.

In a letter to the chairman of the Rapid Transit Subway Commission, Mr. Frank J. Sprague stated that without offering any argument on the question of the advisability of separating, on future subways, contracts for equipment and operation from those of construction, if such a separation be made either by virtue of a decision on the part of the Rapid Transit Commission with plenary power, or because of any mandatory provision of new laws, he will be prepared to bid for the equipment and operation of any subway not operated as a branch of the existing one, but in competition therewith, on plans which will insure a maximum carrying capacity and a greater measure of safety in operation. Mr. Sprague also offered to lay before the commission certain essential facts and conclusions relating to existing equipment and operation as viewed in the light of contract requirements and results accomplished, to the end that there may be incorporated certain essential requirements beneficial to the city and equally binding upon all bidders. We understand that this latter statement has been placed before the commission.

Alternating-Current Railway Systems.

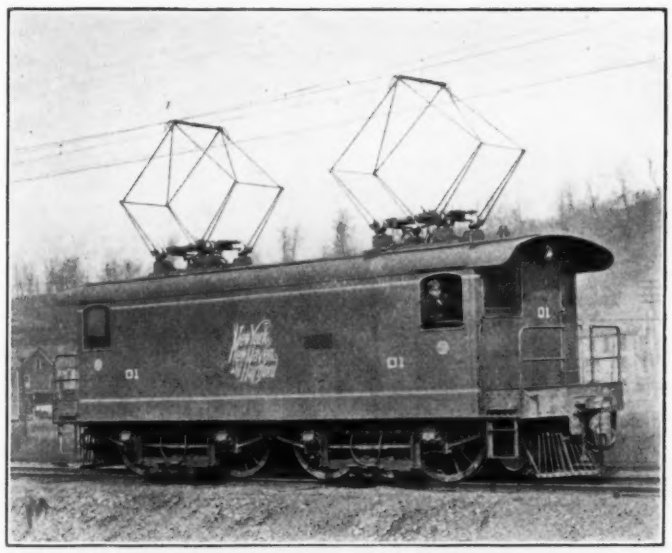
At a meeting of the New York Railway Club, held on March 16, Mr. B. G. Lamme presented a paper dealing with alternating-current systems for heavy railway service, and which dwelt in considerable detail on the equipment designed for the New York, New Haven & Hartford Railroad. A brief abstract of the paper and discussion is given below, more extended notice being reserved for another issue.

The main power house will contain 5,500-kw, three-phase generators driven by steam turbines. Only one phase of each generator will be used at present, so that each machine is rated at 3,750 kw. The 25-cycle currents are fed directly into the catenary trolley system at 11,000 volts.

A view of one of the New Haven locomotives is shown herewith. The running gear consists of two trucks on each of which are mounted two 250-hp, single-phase compensated series motors. The motors are of the gearless type, having a full-load speed of about 225 r.p.m. The armature is not placed directly on the shaft, but is built up on a quill through which the car axle passes. The torque from the armature is transmitted to the wheels through springs which also serve to keep the axis of the armature parallel to the axle of the locomotive. The motors are cooled by air from the blower used for cooling the lowering transformers during alternating-current operation, and the starting resistances during direct-current operation.

The windings of the machines are connected permanently in parallel and require about 450 volts at the terminals on alternating current and from 550 to 600 volts on direct current. On the direct-current part of the line, current is taken from the third rail system, the motors being controlled according to the usual series parallel method. On alternating current the supply voltage is varied, there being no change in the motor connections. No resistance is used in regular running, although a slight amount is used in passing from one working step to the next. There are two transformers for decreasing the potential from 11,000 volts to the value used at the motors.

The controller system is arranged for multiple-unit operation,



ALTERNATING-CURRENT LOCOMOTIVE.

so that two or more locomotives may be coupled to the same load. The main controllers are of the electro-pneumatic unit switch type, and are operated through low-potential relays by means of master controllers, one of which is placed at each end of the cab. Each locomotive is provided with two pantagraph-type, high-tension bow trolleys for collecting alternating current, and with eight shoes for making contact with the low-potential, direct-current third rail. A low-tension overhead direct-current pantagraph trolley is also used in order to conform with certain New York Central requirements.

Each locomotive is expected to handle a 200-ton train in local service on a schedule of 26 miles per hour, the maximum speed being 45 m.p.h. A single locomotive will be able to haul a 250-ton train on through service. For heavier trains it is intended to couple two locomotives together and operate them in multiple.

Mr. W. J. Wilgus said that the motives that guided the New York Central in electrifying the Grand Central division were the elimination of smoke in the tunnel and the improvement of the passenger service. He stated that where a steam railroad finds it desirable to change its motive power it should adopt the system which has been found best by the interurban railways, namely, the multiple unit system, with trains of any desired length and at convenient intervals.

Mr. Calvert Townley, of the New York, New Haven & Hartford Railroad, showed why it was necessary for this road to be electrified. In discussing the selection of alternating-current, high-potential circuits in preference to low-potential, direct-

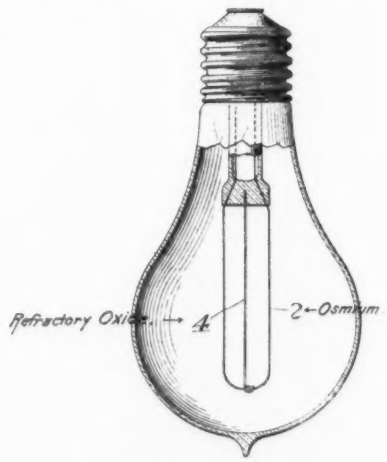
current, Mr. Townley stated that in the former system there is only one link between the bus-bar and the locomotive, namely, the trolley wire. This one link is less liable to cause trouble than if there were used a high-voltage transmission system, a high-tension switchboard, step-down transformers, rotary converters, a direct-current switchboard, a storage battery, a system of direct-current feeders and a 600-volt trolley wire. Investigation seems not to warrant the assumption that the additional risk in using a 11,000-volt trolley wire would afford the possibilities for trouble which would be introduced by the seven or eight links between the power house and the locomotives.

Frank J. Sprague stated that the direct-current railway work had advanced to the stage where it is possible to use 1,500-volt motors. The existence of electrolysis is undeniable, but it would make little difference on a trunk line which, unlike tracks laid in city streets, is not in proximity to water or gas pipes for considerable distances. It appeared that with an 11,000-volt circuit the combined resistance of the trolley wire and rails would give a drop so large that the difference of potential between the rails and the ground would be about 5 per cent of the total potential, or about 500 volts. The effect of such a difference of potential on the telegraph and telephone wires adjoining can be easily imagined. He also asserted that the draw-bar pull of a single-phase locomotive is inferior to that of a direct-current locomotive under similar conditions.

Mr. Lamme, in closing the discussion, took up first the question of flexibility. He said that the alternating-current system had been arranged to make use of the multiple unit control just as well as the direct current. As regards the rail losses, Mr. Sprague's specific figures are correct, but comparing the 11,000-volt New Haven system with the 600-volt New York Central system he thought that the losses in power would turn out to be the other way. As to draw-bar pull, repeated experiments had demonstrated that there are no essential differences between alternating and direct-current locomotives of the same power.

Support for Osmium Filaments.

Osmium filaments for incandescent electric lamps when brought to a dazzling white heat are quite flexible, so that if brought into a horizontal or inclined position they tend to droop or sag by



OSMIUM FILAMENT LAMP.

their own weight. Moreover, owing to the relatively high specific gravity of osmium and a certain degree of brittleness inherent in the filaments, the latter are particularly liable to be broken during transportation, the lamps being of necessity frequently exposed to more or less violent shocks and jars. To obviate these disadvantages and dangers, it is desirable to provide the osmium filament with a suitable support or supports, suitably disposed within the lamp bulb, so as to maintain the filament against excessive flexure or vibration under the varying conditions of use of the lamp and the vicissitudes of shipment and of handling. In a patent issued March 6 to C. A. von Welsbach it is stated that a satisfactory material for the support of osmium filaments is found in an intimate mixture of about ten parts, by weight, of pure thor oxide and about one part by weight, of magnesia. These oxids are mixed in a powdered form and used with a viscous binding material consisting of a solution of sugar. The paste thus produced is shaped into filaments which are dried and subsequently burned in free air until all the organic substance is consumed. Finally they are subjected to a very high temperature until the particles are sintered together. The support is non-adherent to incandescent osmium and is chemically indifferent thereto.

CURRENT NEWS AND NOTES.

MAYOR DUNNE ON ANOTHER TACK.—A dispatch from Chicago states that action was taken by Mayor Dunne on March 14 to get temporary revenue from the street railway companies through car licenses, pending the final settlement of the traction question. An ordinance is being drafted for the licensing of every car.

LARGE CANADIAN PROJECT.—Advices from Montreal state that President Domville, of the Canada Central Electric Railway, says London capitalists have subscribed $20,000,000 for stocks, and that work will be started at once on an electric line from Montreal to Ottawa, thence westward to Toronto. The line will be 670 miles in length. It will invade the territory held between the Canadian Pacific and Grand Trunk Railways.

CONTROL OF WIRELESS.—A special dispatch from Washington of March 17 says: "Legislation for government control of commercial wireless telegraph stations, in accordance with the recommendations of the interdepartmental board appointed by the President two years ago, will be urged on Congress by Secretary Bonaparte. Under the terms of a bill drafted by the board commercial wireless stations would be subject to regulation by the Department of Commerce and Labor, and no station could be established until a license had been obtained. This bill has been pigeonholed until now, but the interests of the navy are said to make it imperative that private stations be regulated because of their interference with the Government service. The bill proposing to enact the desired legislation will probably be introduced in the House and Senate at this session."

MUNICIPAL OWNERSHIP INQUIRY.—In regard to the municipal ownership inquiry now being conducted here and abroad, a cable dispatch from London of March 17 says: "The American commission representing the National Civic Federation has opened a London office and settled down to an exhaustive investigation of municipal ownership, gas, tramways, electricity and supplies. It has selected half a dozen towns conspicuous for excellence of gas, tramway and electric plants, operated either by local authorities or by private corporations, and will make a close examination of the mechanism. The reports of engineering experts will be supplemented by critical analysis of financial results by accountants. The inquiry will be extended to other towns, and the mechanical resources and economic results of municipal and private management will be carefully compared. Incidentally, the relations of municipal trading and local taxation will be brought out. Milo R. Maltbie is conducting the work of the central office with skill and efficiency. J. W. Sullivan has visited Birmingham, Leicester, Sheffield and Manchester, and has started the work of investigation. John B. Klumpp is examining gas and electric plants, and R. C. James is studying municipal accounts. N. M. Crawford, the Hartford street railway engineer, and Albert E. Winchester, superintendent of the South Norwalk electric works, are expected in London within a fortnight. A staff of two accountants from the tramway, gas and electric engineers has been organized for carrying on the work under the six American commissioners, and Birmingham, Manchester, Sheffield, Liverpool, Glasgow and Newcastle will be the towns chosen for thorough investigation. Bristol, Leeds, Dublin and other towns may be included in this practical survey of municipal activities in the United Kingdom."

BRITISH TELEPHONY.—The National Telephone Company, of England, reports that 1,053,000,000 messages were sent over its system in 1905. The increase in the use of the telephone is shown by the fact that 1905 calls were 53,000,000 in excess of 1904.

AUTOMOBILE IGNITION.—At the meeting of the Automobile Club of America on March 27, at the clubhouse, 753 Fifth Avenue, New York City, Mr. Clarence B. Brokaw will lecture on "Various Methods of Ignition: Dry and Storage Batteries, Dynamos, High and Low-Tension Magnetos."

POWER IN MEXICO.—The Mexican Light & Power Company announces that it has two units in operation from its electrical plant at Necaxa, and has closed its steam plant in the City of Mexico; 13,000 hp is being delivered into Mexico City and 4,500 into the El Oro mining district. The Necaxa system was illustrated and described in these pages last year.

N. E. L. A. TRANSPORTATION.—Mr. G. F. Porter, master of transportation of the National Electric Light Association, informs us that the Southeastern Passenger Association and Western Passenger Association have authorized a rate of a fare and one-third, on the certificate plan, from points in their respective territories to Atlantic City and return, for delegates and their friends attending the twenty-ninth convention of this association, to be held at Atlantic City, N. J., June 5 to 8, inclusive.

LONG ISLAND THIRD RAIL.—The electrification of the Long Island Railroad system is going forward steadily and already comprises 96 miles of single track over which 172 scheduled trains run daily. A host of summer residents on Long Island are looking forward anxiously and eagerly to the months when they will have to test the improvement in the train service effected by electricity, as compared with last summer, when the conditions of the period of transition were frequently intolerable.

SALT LAKE ELECTRICAL SHOW.—The electrical show fever is becoming epidemic, and will probably have to run its course. Salt Lake City is now to have a show and a number of people connected with electrical interests there and with the Utah Light & Railway Company have organized such an affair to be held for ten days begiming April 2. It is the first of the kind in that part of the country and ought to prove atractive. The announcement from Mr. B. W. Mendenhall, chairman of the publicity committee, says that the show is already an assured success.

A PRIZE ESSAY.—To encourage local interest in, and appreciation of, the benefits of electric current supply for the household, the Janesville, Wis., Electric Company offered three prizes for essays on the subject by students in the high school, the prizes being $10, $5 and $2.50. Some excellent work was turned in and the first prize was won by Wallace Mills, son of Dr. J. Mills, secretary of the Palmer Memorial Hospital. The essay is printed by the local *Gazette,* and its succinct enumeration of the things that electricity can do for the family and the home cannot fail to be productive of inquiry and increased consumption of power and introduction of apparatus.

UNVEILING STATUES is a performance that is not always gone through gracefully or without hitches. Mr. J. S. Hill, an electrical engineer connected with the Interior Department, has invented a new apparatus for use in the unveiling of statues. The invention consists of a series of magnets and electrical apparatus placed at different points in the drapery concealing the statue to be unveiled. By its use the covering falls gracefully from the figure, and the hitches which so frequently occur in the removal of the drapery from statues to be unveiled are avoided. Mr. Hill has not secured a patent on his device and will give it to the French Government if it is desired for the approaching ceremony in connection with the presentation of the Franklin statue in Paris.

HARMONIC SIGNALING.—At Pittsburg, on March 13, 235 electrical engineers gathered at the Carnegie Technical School at a meeting of the Pittsburg branch of the American Institute of Electrical Engineers, Chairman S. P. Grase presiding. Telephony was the subject discussed. Harmonic signaling party line telephone systems was the most prominent point brought out by the discussion. The following were the speakers and topics: A. D. T. Libby, power engineer Dean Electric Company, "Power Apparatus for Harmonic System"; R. L. A. Snyder, construction engineer Central District & Printing Telephone Company, "Telephone Cables"; L. Millheizer, superintendent of maintenance Pittsburg & Allegheny Telephone Company, "Advantages of Harmonic System"; M. C. Rorty, traffic superintendent Central District & Printing Telephone Company, "Telephone Traffic"; S. P. Grace, chief engineer Central District & Printing Telephone Company, "The Telephone Line."

TELEPHONE BEGINNINGS.—At the annual banquet of the Brantford (Ontario) Board of Trade, interest centered largely in the presence of Prof. Alexander Graham Bell, inventor of the telephone, whose name and fame Brantford will shortly perpetuate by the erection of a suitable memorial in that city, which is the birthplace of the telephone. Prof. Bell told the story of his work at Brantford, where the first actual transmission of speech took place, in the summer of 1876. "It took place," said Dr. Bell, "over the telegraph wires of the Dominion Company, extending from Brantford to Mount Pleasant, a distance of five miles." Mr. Bell was at the Mount Pleasant, or receiving, end of the wire, the messages being transmitted only one way, as the instruments would not permit of reciprocal service. A given time was fixed when his uncle should speak into the transmitter at Brantford. At the receiving end Bell waited patiently, and when the time came he heard quite distinctly his uncle's voice five miles distant, the first words being "To be or not to be." "It was a case of to be," the speaker remarked, amid applause. Other similar tests followed in various parts and the inventor then gave his attention to perfecting the invention. On March 10, 1876, the first telephone message was sent by Dr. Bell, in Boston, to his co-worker, Mr. Thomas A. Watson, at a boarding house in Exeter Place, and in June the apparatus was shown at the Philadelphia Centennial Exposition.

INTRODUCING ELECTRIC FLATIRONS.—A great many central stations, especially in smaller towns, have experienced somewhat indifferent success in attempts to induce customers to try electric flatirons. This is largely because proper methods have not been followed or because the work has been carried on in a half-hearted manner. Many managers of central stations have considered that they have given such devices a fair introduction when they sent manufacturer's circulars and literature enclosed with monthly statements or have given to manufacturers lists of their most likely customers, so that they do the circularizing themselves. Other managers have fitted up irons in their offices and have given practical demonstrations of the advantages of the devices whenever good customers have happened in the office. Some have assisted local supply houses in introducing the devices, while a comparatively few have had sufficient faith to buy a few and give demonstrations in homes of prospective customers. The W. J. Barr Manufacturing Company, of Cleveland, Ohio, manufacturer of a line of irons, is carrying on an interesting campaign of missionary work. The company has a number of representatives constantly in the field, who go to lighting plants, secure the names of possible customers, and place irons in the hands of such people on two weeks' trial. They make personal demonstrations and give thorough instructions as to how the devices should be used, indicate the best sizes for certain service, and otherwise convince customers that this is a practical, convenient and economical innovation. Then the company either closes up the orders or gets the lighting company to do it. In the latter case the lighting company is given a trade discount and allowed 30 days' time in which to collect from customers.

JAPANESE WIRELESS TELEPHONE.—A dispatch from Tokio, Japan, March 15 states that the Admiralty has announced the invention of a wireless telephone by an engineer named Kimura. Great as the Japanese are in the practice of the arts, their inventions still seem to be few and far between.

LYNN ENGINEERING SOCIETY.—The Lynn General Electric Engineering Society has had its annual election, and the new officers are as follows: President, Mr. R. Fleming; vice-president, Mr. G. E. Sanford; secretary, Mr. J. A. Howe; treasurer, Mr. E. M. E. Humphries, and assistant treasurer, Mr. F. M. Shaw.

APPARATUS FOR BRAZIL.—The government budget estimates of expenditure of Brazil for 1906 make provision for the disbursement of certain sums on meteorological apparatus, light houses, life-saving apparatus, submarine construction, telegraph and telephone lines. Provision is also made for the free importation of hydro-electric plants.

POLES AT LOS ANGELES, CAL.—All poles and overhead wires owned by telephone and electric lighting companies in Los Angeles have been ordered down by the municipal authorities in an extended district in the business section of the city, as defined by a conduit ordinance just passed. Seventeen corporations have been notified that they must comply with this regulation.

TANNING BY ELECTRICITY.—United States Vice-Consul-General Hill, of Halifax, Nova Scotia, reports that the demonstration plant there for the tanning of leather by electricity has proven a success, and a company will now start a regular tannery. The rights for Canada have been purchased from the Boston inventor. This process is said to take only thirty days to manufacture against the three to four months of the old methods, and produces better leather.

USE OF MEANS OF COMMUNICATION.—It is stated that in 1904 the number of letters and postal cards in the United States per 1,000 population were 65,406; of telegrams, 1,125; of telephone talks, 40,600. In Europe the number of letters and postals per 1,000 were 29,717; of telegrams, 738, and of telephone talks, 6,904. The ratio of letters and telegrams appears to be diminishing rapidly on account of telephonic growth. The use of the picture postal must distort the figures somewhat, but it may be some time before that craze dies out.

THE DUTCH POINT STATION.—In the hurried preparation of descriptive material, the name of the designing engineer is often divorced from his work; and if the latter be especially distinguished by extraordinary skill in overcoming almost insuperable obstacles or is an example of particularly good engineering, this chance omission works an injustice. It is with pleasure, therefore, that we accord this belated recognition of work well done at the Dutch Point Station of the Hartford Electric Light Company, lately described in our pages, to Westinghouse, Church, Kerr & Co., who designed and constructed this property from the bottom of its difficult foundations to its last detail of refinement.

TELEGRAPH RIGHTS IN CHICAGO.—According to a dispatch from Chicago Assistant Corporation Counsel Maclay Hoyne declares it as his opinion that the Western Union Telegraph Company and the Postal Telegraph Company have no rights in that city. Mr. Hoyne holds that under the decision of the United States Supreme Court on the Ninety-nine-Year act, the City Council may pass a general ordinance compelling the telegraph companies to pay for the right to occupy streets with their poles and wires, and also on their interstate business passing through Chicago. Mr. Hoyne declares that any rights the telegraph companies may have had in the past are done away with by this decision, and that the city, if the companies refuse to pay compensation, can take steps to oust them from the city.

HAMILTON (OHIO) MUNICIPALISM.—The *Ohio State Journal* of March 11 says: "Gross mismanagement of the municipal electric light plant, the gas plant and the water works are the features of the criticism by the Bureau of Uniform Accounting Examiners in their report upon the affairs of Hamilton, Butler County, filed yesterday. It is stated that ex-officials, present officials and prominent business men of political influence have been furnished free light and fuel service for months, while private enterprises have been allowed thousands of dollars' worth of similar service. The delinquent list of patrons of all three plants is surprisingly large and altogether the report indicates a gross laxness in the management of all three plants. All of the accounts of the three plants are badly muddled and poorly kept."

ALUMINUM PRODUCTION.—It is estimated by the *Wall Street Journal* that the output of aluminum during the year 1905 amounted to 10,000,000 pounds, and as the Pittsburg Reduction Company, the sole manufacturer of the metal in the United States, is increasing the capacity of its plants with expectations that by the end of the current year production will be doubled, it can be readily approximated what the 1907 output will be. The aluminum industry in this country began in 1883 with an output of but 83 lb.; this had nearly doubled in the next year and in 1885 amounted to 283 lb. In 1890 it had grown to 61,281 lb.; to 920,000 five years later and to 7,150,000 lb. in 1900. Some few years before the manufacture of the metal in the United States was commenced the first recorded importation of aluminum was made when an amount, not given, but valued at $98, was brought into this country, in 1870.

FLOW AT NIAGARA.—In a recent editorial on the alleged impending destruction of the American Falls, the New York *Times* says: "That Senator Teller has spoken hastily and inadvisedly the following facts show: Dr. John M. Clarke, the New York State Geologist, says that the sill or edge of the falls is ten feet higher on the American than on the Canadian side; the waters at the crest of the American side are ten feet shallower. Let the entire flow be reduced by 80,000 cubic feet a second and the American Falls will have vanished, leaving a precipice of dry rock. The charters of the two American and three Canadian companies already allow an abstraction of 48,000 cubic feet a second, and developments on the Canadian side have been planned that will require the use of an additional 70,000 cubic feet a second for power purposes. Engineering difficulties, park restrictions and legislative prohibitions have effectually discouraged efforts on this side to further deplete the falls. Yet an increased allowance by the Canadian authorities of 32,000 cubic feet a second would sound the death knell of the American Niagara."

THE METRIC SYSTEM IN CANADA.—United States Consul Seyfert, of Stratford, reports an active movement in Canada that has for its object the adoption of the metric system of weights and measures. Active propaganda is at work to have the question properly presented to the Canadian people. The consul writes: "With a view of adopting the metric system in weights and measures at an early day the Canadian Government is preparing and educating the people for the change. Prof. J. C. McLennan, of the University of Toronto, has been engaged by the Dominion Government to devote the next year to explaining the system in a series of lectures in all the leading cities from Halifax to Vancouver. The professor delivered his first lecture on the subject at Stratford February 7, before the Board of Trade. According to his explanation it is the object of the Canadian Government to secure a uniform standard of weights and measures throughout the entire British Empire, and thus to advance trade relations among the different colonies of the empire. The Board of Trade at Stratford unanimously adopted resolutions, urging adoption of the system."

OHIO ELECTRIC LIGHT CONVENTION.—The place and date of the next convention of the Ohio Electric Light Association have been arranged. It will be at Hotel Victory, Put-in-Bay Island, August 21, 22 and 23. The first session will probably be held Tuesday evening, August 21.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.—The date of the meeting of the Southwestern Electrical and Gas Association has been changed from the second Tuesday in May to May 16, 17 and 18. It will be held at Galveston, Tex. Frank J. Duffy, of Beaumont, Tex., is secretary of the association.

POWER OF THE RHINE.—United States Consul Brittain, of Kehl, writes that the German manufacturers of upper Alsace and upper Baden are perfecting plans to develop the water power of the Rhine. The fall of the river between Basle and Neuenburg is 267 ft. and between Neuenburg and Breisach 77 ft. It is proposed to erect three power houses, the first at Rheinweiler, with 60,000 hp, to supply the city of Mulhausen. The power house to be constructed at Breisach will develop 24,000 hp.

FOREIGN TRADE.—The Bureau of Statistics of the Department of Commerce and Labor reports a splendid foreign trade for February. The imports were $104,201,884, as compared with $103,057,052 last year; but the exports were $141,719,650 as compared with $109,024,069. The eight months, including February, shows imports of $799,926,525 and exports of $1,198,346,309, a merchandise trade balance of $398,419,784, or over one hundred millions more than for the same period last year, and about five millions more than 1904.

WESTERN UNION JUBILEE.—An interesting telegraph jubilee is near at hand. The Western Union Telegraph Company on April 4 will have rounded out 50 years of corporate existence. A charter was granted to the company on April 4, 1856. Its immediate predecessor was the New York and Mississippi Valley Printing & Telegraph Company, which was merged with the Western Union Company. The company now has a network of wires and cables under the North Atlantic and throughout the North American Continent. Up to the time of the foundation of the company the telegraph development of the country had been almost as chaotic as that which has been witnessed during the last five years in independent telephony.

SINGLE-PHASE FOR ENGLAND.—The London, Brighton & South Coast Railroad Company, of England, has decided to operate part of its lines by the Winter-Eichberg single-phase alternating-current electric traction system, the British patents for which are controlled by General Electric interests. There will be about 75 miles of track from London to Brighton, etc., electrified at a cost of about $3,000,000. All trains entering both the London terminals will be handled by electric locomotives. Thirteen tracks are operated at Victoria and eleven at London Bridge. Each train will consist of three cars, two being motor cars, each with four motors developing 600 hp. This is the largest conversion contract so far in England, but others are said to be coming.

ELECTRIC POWER IN INDIA.—Plans are now being perfected for the generation of electric power on a large scale in the Punjab for transmission to Lahore and Amritsar, the Punjab Power Association of London having been formed for the purpose. The power is to be generated on the Dari Canal and transmitted over a distance of 70 miles to Lahore and 100 miles to Amritsar. Coal at the points of delivery of the power now costs from $5 to $6 a ton, and it is expected that the low price at which electric power will be supplied will give a general interest to industrial undertakings at both cities. The United Provinces Power Association of London has also been formed to develop water power on the Jumna River and to transmit electric power to Delhi, 140 miles distant, and possibly to Simla, 95 miles distant in the opposite direction.

POWER FOR OGDENSBURG, N. Y.—A special telegram from Potsdam, N. Y., of March 17 says: "The longest electrical power transmission line in the East, with the exception of lines running from Niagara Falls, was successfully put in operation here at midnight last night. It is the transmission line of the Northern Power Company, of Potsdam. The power is developed at the plant of the Hannawa Falls Water Power Company, at Hannawa Falls, on the Raquete River, near here, and runs across the country 35 miles to the city of Ogdensburg, where the power is delivered to the Ogdensburg Street Railway Company, which uses it to operate the street railway and lighting systems of that city. A number of engineers were present to witness the tests, which showed the line to be completely successful. The current is sent over aluminum circuits. W. C. Johnson, of Niagara Falls, is the consulting engineer and W. T. Cogswell and E. J. Page, of Syracuse, are the president and vice-president, respectively, of the Northern Power Company."

TUNNEL RECOMMENDATIONS IN NEW YORK.—The Rapid Transit Commission, in a formal communication to the Board of Estimate and Apportionment, has recommended a four-track electric subway branching from the Fourth Avenue-Hamilton line at Thirty-sixth Street, Brooklyn, and running as a subway to Eighty-sixth Street and Bay Thirty-fifth Street, in Unionville, and then as an elevated system across the low-lying ground at the edge of Gravesend into Stillwell Avenue, in the heart of the amusement district in the West End. The subway will cost about $8,000,000. In effect the new section will be an extension of the Fourth Avenue and Fort Hamilton subway, the plans for which were approved by the Rapid Transit Commission on July 14 last and by the Mayor on July 28. This last section is so planned that connections can be made with the subway now under construction, and with the Prospect Park extension heretofore authorized, and also with the Brooklyn and Manhattan loop lines approved by the commission on July 14.

OWNERSHIP IN SEATTLE.—A special telegram from Seattle, Wash., of March 7 announces a very narrow victory there for city ownership. Mr. William Hickman Moore, municipal ownership candidate for mayor, was elected on a platform pledged to municipal ownership of public utilities, by a majority of 15. The vote was: Moore, 8,490; Riplinger, 8,475. Seattle is nominally Republican by 3,500, and has always, since its foundation, had a Republican mayor. Moore proposes to build in outlying sections of the city a street car system to compete with the present system operated by Stone & Webster, of Boston. The charter amendment submitted to the voters providing that no franchise for street car purposes shall be granted in the future that does not contain a clause providing that the city have joint use of the tracks on payment of half the cost of construction and maintenance, and also containing a provision for acquisition of the line in entirety by the city at any time it sees fit, was carried by a large majority. The cost is to be fixed by arbitration.

SOURCES OF RUBBER.—The high price of rubber makes new sources more welcome than ever by electrical manufacturers. United States Consul-General Guenther, of Frankfort, quotes the report of the well-known African explorer, Harry Johnston, to the effect that the Republic of Liberia, in West Africa, possesses an almost unlimited supply of rubber trees. This news, he writes, is all the more remarkable, as heretofore Liberia exported hardly any caoutchouc. Johnston stated in a lecture before a company which has received a concession for the production of rubber in Liberia, that an extraordinary amount of that article is to be found there, that it only awaits collection, and that he did not hesitate to say that within six years 2,500,000 of cultivated rubber trees, furnishing an excellent quality of rubber, will be yielding sap. Another report states that at least 20,000 English square miles are covered with dense rubber tree forests. It is also stated that various creepers are found there containing rubber which heretofore have been unknown. Should these reports be based on facts the rubber industry will be greatly benefited.

The Houston, Tex., Lighting and Power Company.

HOUSTON, the second largest city in Texas, a prosperous, go-ahead community with about 60,000 population, was one of the first cities in the South to have a central station, and although the lighting business in Houston has passed through more than the ordinary run of financial and physical vicissitudes, the plant by recent additions and improvements has been put into first-class shape and the property gives promise of a thoroughly successful and prosperous future. All of the public electric lighting and power facilities of the city are now operated by a company whose corporate title is "Houston Lighting & Power Company—1905."

The present company is doing business under privileges and franchises originally granted by city ordinance in February, 1888, to the Fort Wayne-Jenney Electric Light Company, of Fort Wayne, Ind. These franchises together with the plant were later assigned by the Jenney Company to the Citizens' Electric Light & Power Company. In January, 1898, this latter company went into the hands of a receiver. In March, 1898, the original plant was partially destroyed by boiler explosion and the day following was totally destroyed by fire. For two years the company filled its lighting and power contracts by buying power wherever available from private isolated power plants in different parts of the city.

During this period subsequent to the fire the company built a new plant which was placed in operation in the spring of 1900. In December, 1901, the property was sold at receiver's sale and was purchased by a new company known as the Houston Lighting & Power Company, in which the General Electric Company, of Schenectady, was largely interested. Last year Isidore Newman & Son, of New Orleans and New York, became financially interested in the enterprise and the present company was organized to take over the property. The plant and lines are being overhauled and rearranged under the direction of Ford, Bacon & Davis, of New York, consulting and constructing engineers.

The plant erected in 1900 contained two 300-kw generating units and three 350-hp boilers. In the summer of 1901 there were added a 600-kw unit and an additional 350-hp boiler. In the summer of 1902 another 600-kw generating unit and an additional 350-hp boiler were installed, and in 1905 the station was increased to its present capacity by installing a 1,500-kw Curtis vertical turbo-generating unit and three 500-hp boilers.

During this period there has been going on an entire reconstruction of poles and lines; mains have been extended and new lines built. The company now has about 600 miles of distribution lines, all overhead, carried on some 5,000 poles ranging from 35 ft. to 50 ft. in height. The present connected load includes an aggregate of over 1,600 hp in small motors varying from ¼ to 100 hp each; about 50,000 16-cp equivalents in incandescent lights; 1,600 street and commercial arc lamps, and 600 city arc lights.

The city is primarily a railroad town and a considerable portion of the motor and lighting load comes from the railroads entering the city, most of which have extensive shops at this point and all of which are required to light the locations where they cross city streets. The railroads pay $100 per lamp per year for lights at these locations. The other motor load comes from machine shops, grain elevators, public and private

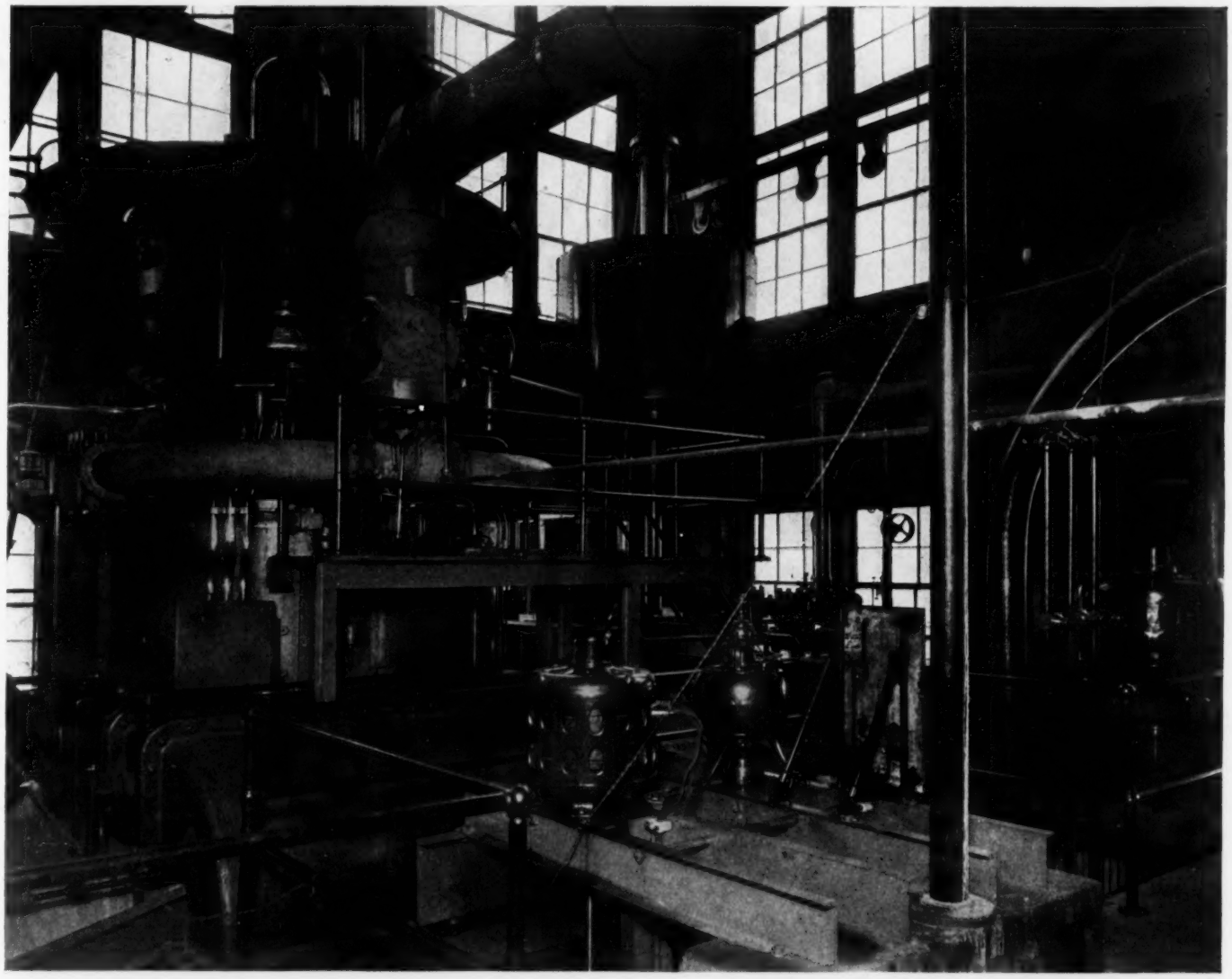


FIG. 1.—VIEW OF TURBINE AUXILIARIES, SHOWING PARTICULARLY APPLICATION OF INDUCTION MOTORS.

buildings and factories of various kinds. Many of the industrial and manufacturing plants in the city, including an entire newspaper establishment, are operated exclusively by electric power supplied from the lighting station.

Aside from the physical property of the Houston Company, not the least noteworthy phase of the enterprise is the remarkable growth in the company's activities, despite the many vicissitudes and setbacks. During the past four or five years the connected load has been largely increased, and this has come about not so much by strenuous activity on the part of an elaborate contract department, as through the advertising secured by means of an excellent service at fair rates. It has been the business policy of the management to keep the capacity of the plant in advance of the needs of the city, and not so much to make the patronage justify the plant as to make the plant justify the patronage. Up to the present time comparatively little systematic soliciting has been done, and but little advertising other than an effort to have it known generally among the citizens of the city that the company's service was good and its rates reasonable. As a result of the recent enlargement of the power facilities, however, the company is now organizing a contract department for the purpose of more carefully and systematically handling the new business with reference to the rapidly growing city.

The company has a contract with the City of Houston, dated March 3, 1903, for furnishing street lights for a period of six years therefrom. Under this contract the company is required to furnish 425-watt, enclosed arc lamps, running 4,000 hours per year, for the sum of $85 per lamp per year for a period of four years for all lamps up to the number of 450. If, during this time, the city shall order enough lamps installed to exceed 450, then the price per lamp for all in excess of 450 shall be at the rate of $80 per year per lamp. At the end of four years all lamps furnished to the city are to be charged for at the rate of $80 per lamp per year, less 2½ per cent if paid before the 15th day of the month. The contract provides that if at the end of four years the city has built and is operating its own electric light plant, or at any time thereafter, the contract can be canceled by the city giving 60 days written notice. The rate for lighting in the buildings owned or rented by the city is to be charged for at the rate of 5 cents per kw-hour. The cost of changing the location of street lights is to be paid for by the city.

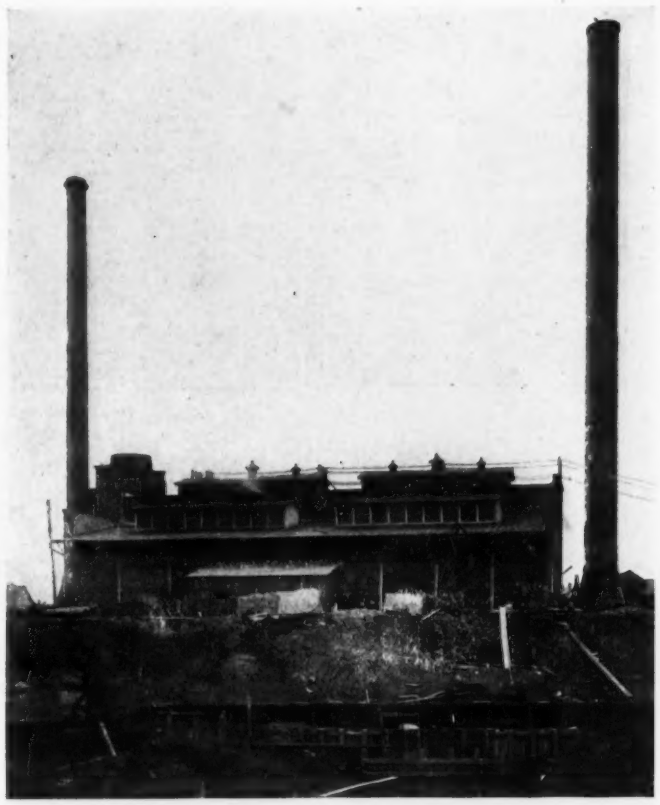


FIG. 2.—VIEW OF POWER HOUSE FROM REAR.

GENERATING STATION.

The generating station is located on the Buffalo Bayou, the latter a Southern term derived from the French for a sluggish inlet from a lake or bay, and is applied more particularly to the many narrow arms, often resembling rivers, that extend from the Gulf of Mexico back into the land, often for a hundred miles or more. At the particular point on the Buffalo Bayou where the Houston plant is located, the bayou takes the form of a deep ravine, and the floor of the engine room is about 50 ft. above normal water level. This situation admitted of an interesting treatment of the condensing layout which will be described later. At Houston, which is about 50 miles from the Gulf, the water in the bayou is normally fresh, although it becomes brackish a little further down toward the sea.

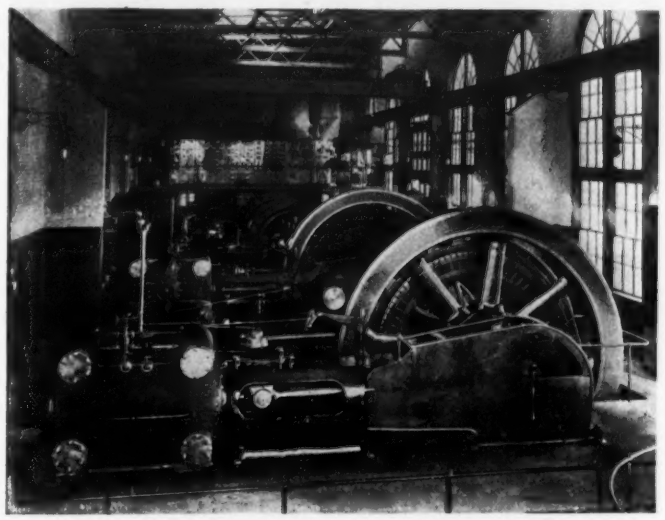


FIG. 3.—GENERAL VIEW OF POWER HOUSE INTERIOR.

The present power house is a two-story brick building 172 ft. x 42 ft. with boiler room extension 155 ft. x 44 ft. The engine room is two stories high with tower three stories and attic. The boiler room is one-story high with open loft. The engine room floor and roof are structural steel frame work, the roof being covered with porous tile and composition. The roof of the boiler room is corrugated iron. All walls except partition wall between engine and boiler room are 17 ins. thick. The partition wall is 13 ins. thick. The entire front of the building is faced with buff brick with stone window-sills and belt courses and terra cotta coping.

There are two 300-kw General Electric alternators each direct-connected to a McIntosh-Seymour horizontal cross-compound condensing engine with cylinders 14x28x32 ins., each rated at 500 hp; and two 600-kw General Electric alternators each direct-connected to a Rice & Sargent horizontal cross-compound condensing engine having cylinders 18x36x42 ins., and rated at 1,000 hp each. These four units are located in the older portion of the station, and up to a year ago were sufficient to carry the load satisfactorily. As previously stated, however, during 1905 the engine and boiler rooms were extended and the generating apparatus was increased by the addition of a 1,500-kw Curtis vertical turbo-alternator; a 1,500-kw, 900 r.p.m., 2,300-volts, 377 amps., 8-pole unit, and is said to be the first Curtis turbine turned out at the Lynn plant of the General Electric Company. The addition of this unit at the Houston power station required a complete new installation of condensers, condenser pit and auxiliary apparatus, the work involving a number of unusual and noteworthy features. The turbine installation includes a counter-weight accumulator for feeding water supply to the step bearings of the turbine; two 7½x2x6-in. duplex plunger pattern Worthington pumps for pumping the water used in the step bearings; and one oil pump set consisting of two 2x1⅛x2¾ in. duplex pumps and tanks for furnishing lubricating oil to the turbine.

All of the generating units at this plant generate three-phase, 60-cycle currents at 2,300 volts. The current is sent at this voltage throughout the city and delivered to customers through local transformers placed at convenient locations. From these mains is carried the alternating-current commercial lighting load and also a considerable number of induction motors of various sizes for various purposes.

For supplying direct current for commercial incandescent lighting and the direct-current motor load, there are located at the main power plant two 100-kw and two 300-kw General Electric rotary converter sets with their transformers. The converters making up the first-mentioned group are 6-pole, 100-kw, 1,200-r.p.m., 182-amp. machines. They receive the initial current through one transformer set consisting of three air blast trans-

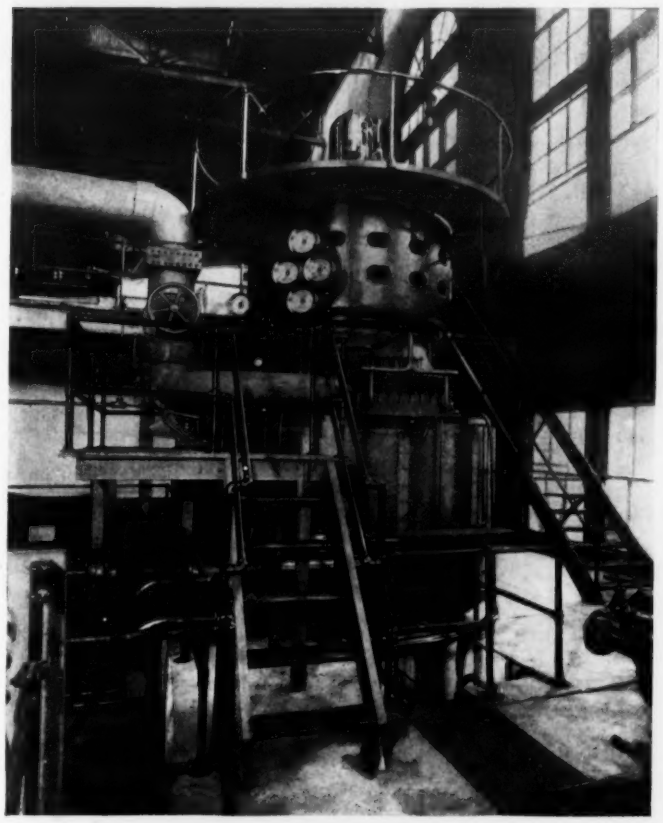


FIG. 4.—VIEW OF CURTIS TURBINE.

FIG. 5.—TURBINE AND ENGINE-DRIVEN ALTERNATORS.

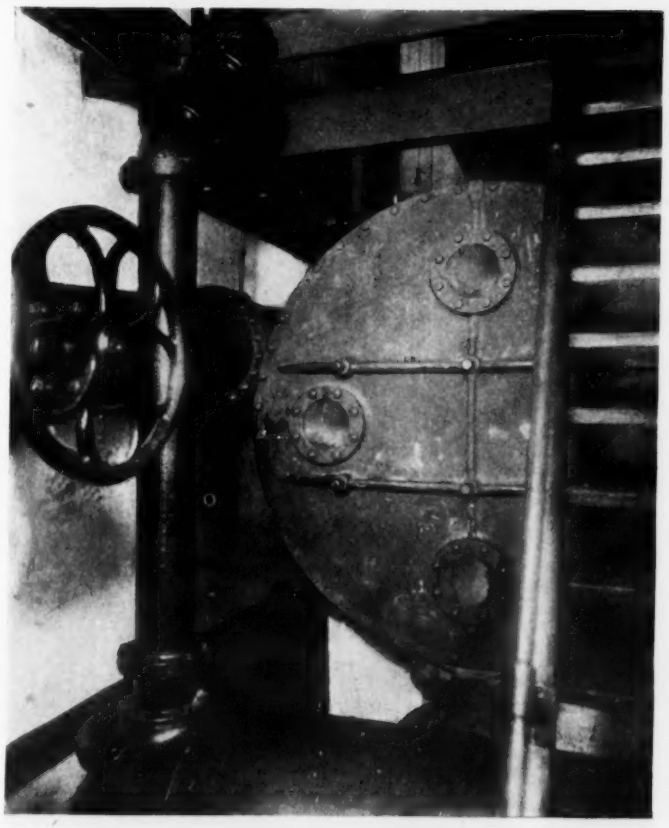


FIG. 6.—END VIEW OF CONDENSER.

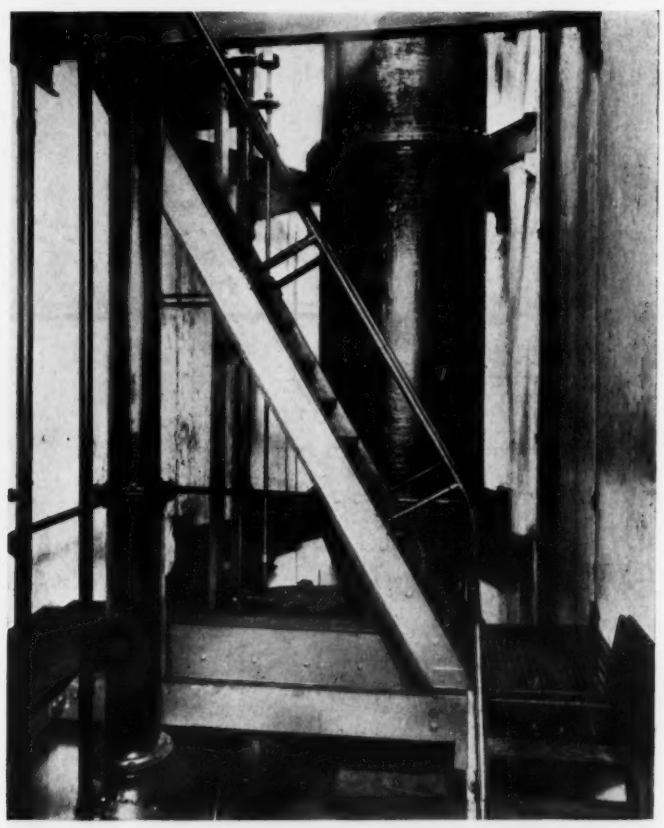


FIG. 7.—NEW CONDENSER PIT.

formers rated at 75 kw, which receive current at the primaries at 2,300 volts and deliver it at the secondaries at 375 volts. The converters deliver 550-volt direct-current. For delivering the air blast to the transformers there is a Buffalo Forge Company 9-in. steel blower direct connected to a General Electric 3-hp induction motor.

The converters comprising the second group are 8-pole, 300-kw, 900-r.p.m. machines. They receive current through two transformers rated at 330 kw, which deliver at the secondaries 430-410-volt alternating-current. These transformers are also of the air-blast type, air being supplied by two 35-in. blower sets driven by induction motors. The blower outfits for the transformers are suspended from the ceiling in the sub-basement beneath the transformers and deliver the air up through the floor in sheet metal air ducts.

For supplying the city arc circuits there are six 100-light "tub" transformers located in a separate fireproof vault at one side of the engine room.

The auxiliary electrical apparatus at the station includes three motor-driven exciter sets, each consisting of a 25 kw generator coupled direct to a 37-hp, 220-volt induction motor. These exciter sets are used for starting the generating units when current is available. For starting after a complete shut down, there is an auxiliary exciter set consisting of a 30-kw generator driven by an 11x8-in. vertical marine type engine.

The switchboard is arranged on a steel frame platform at one end of the building. It comprises 16 alternating-current panels and 8 direct-current panels of blue Italian marble on which are mounted a full equipment of standard instruments and appliances.

The engine room is spanned by a 15-ton hand power overhead traveling crane having 37-ft. 9-in. span and a lift of 17 ft. The crane was furnished by the Wellman-Seaver Engineering Company of Cleveland.

The boiler room equipment consists of three 350-hp Cahall boilers, two 350-hp and three 500-hp Babcock & Wilcox boilers. All of these are fitted to burn oil as fuel. The three boiler units last mentioned were installed to serve the turbo set. They are fitted with internal superheaters and deliver steam at 200 lbs. pressure. The other boiler units supply the reciprocating engines and deliver steam at 140 lbs.

Water from a 1,200-ft. natural flow artesian well is used for boiler feeding. The feed water is forced to the boilers by one 10x6x10-in. horizontal duplex pressure pattern feed pump made by Worthington, three 10x7x10-in. duplex feed pumps made by George F. Blake Manufacturing Company, and one 5½x3x6-in. duplex feed pump made by George F. Blake Manufacturing Company. There is a Webster vacuum feed water purifier and filter and a 1,000-hp vertical open heater made by Stillwell-Bierce & Company.

CONDENSER ARRANGEMENT.

As the base of the turbine is approximately 50 ft. above the average water level in the Buffalo Bayou, from which condensing water is taken, it was thought best to place the condenser at the bottom of a deep pit rather than attempt to lift the circulating water so high. Accordingly all the apparatus pertaining directly to the condensing system is located at the bottom of a pit, which is approximately 10 ft. square and 43 ft. deep measured from the base of the turbine. The pit was constructed of steel I-beams and concrete reinforced with expanded metal in the sides. The turbine condenser, which is of the Worthington surface type rated at about 6,000 sq. ft. capacity, is supported near the bottom of the pit, and the exhaust from the turbine reaches the condenser through a 48-in. cast iron pipe. Immediately below the condenser and forming part thereof is a hot well comprising a square cast-iron box which receives the condensed water. This hot well in addition to supplying a portion of the feed water required by the boilers, serves also as a reservoir from which is drawn the water used in the step bearing under the revolving part of the turbine.

The circulating water for the condenser is taken from the bayou through a 16-in. suction pipe, passes through an air cooler located on the end of the condenser, into the bottom of the condenser, through the condenser and back to the bayou through a 24 in. discharge pipe. The intake and discharge mains are carried on cradles inside a brick tunnel about 100 ft. long, extending from the power station building to the bank of the bayou. The water is circulated by a 16-in. vertical centrifugal

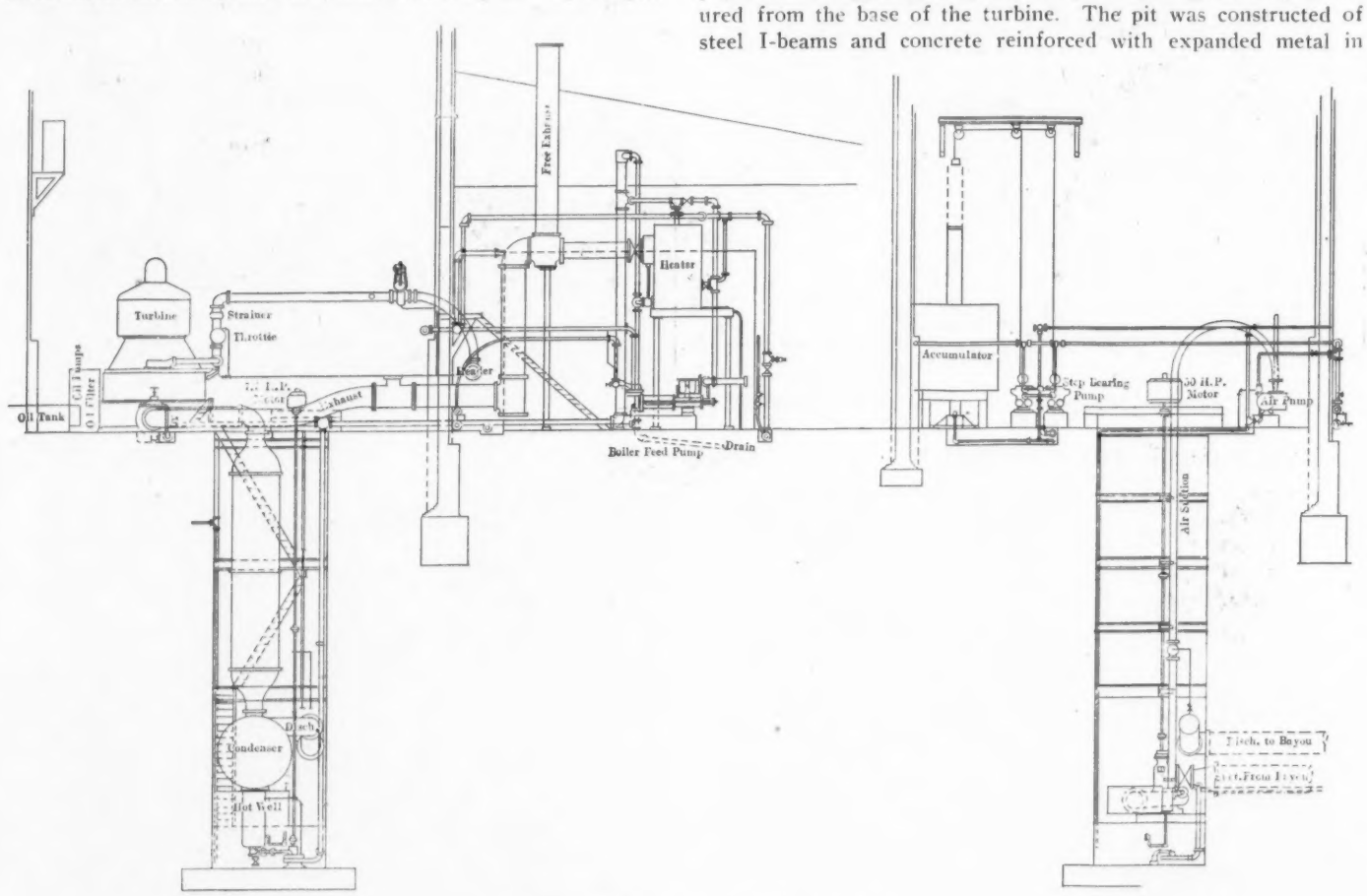


Fig. 8.—Piping Sections, Houston Plant.

circulating Worthington pump driven by a 50-hp, 220-volt, three-phase induction motor. In order to keep the motor dry, it is located at the level of the top of the condenser pit and drives the pump through a vertical shaft. This shaft, as shown in the accompanying drawings, is supported at intervals by side bearings attached to the framework of the pit.

The vapor is drawn from the top of the condenser by a steam driven 8x16x12-in. single horizontal rotative dry vacuum pump of the center crank pattern made by Worthington. The course of the vapor is from condenser, through an air cooler at end of condenser, through pump to atmosphere.

For lifting the water from the hot well there is a 3-in. two-stage centrifugal hot-well pump located at the bottom of the pit and driven through a vertical shaft by a 7½-hp induction motor located at the top of the pit. This pump lifts the water from the well and delivers it to the feed-water heater, but at a point near the top of the condenser a portion of this water is diverted to the step-bearing pumps, by which it is forced to the turbine bearing.

In order to prevent the possibility of seepage water accumulating in the condenser pit, a 2½-in. vertical volute Worthington pump is provided at the bottom of the pit. This pump is driven through a vertical shaft by a 5-hp induction motor located at the top of the pit.

The station log at this plant shows the following averages: Vacuum, 27.6 in.; temperature of hot well, 84° F.; temperature of condenser injection water, 76° F.; temperature of discharge water 70° F.; temperature of feed water, 138° F.

The condensing apparatus for the reciprocating engine units is located in a separate compartment, 34 ft. deep, under the old portion of the plant. The apparatus comprises two 9x20x12-in. jet condensers with vertical twin vacuum air-pump; one 12x28x18-in. jet condenser with similar pump; and one 16x40x21-in. jet condenser also served by the same type of air pump. These condensers and pumps were furnished by the George F. Blake Manufacturing Company. Circulating water for this group of condensers is taken from, and discharged into, the bayou through mains laid in a tunnel in about the same way as described for the turbine condensers.

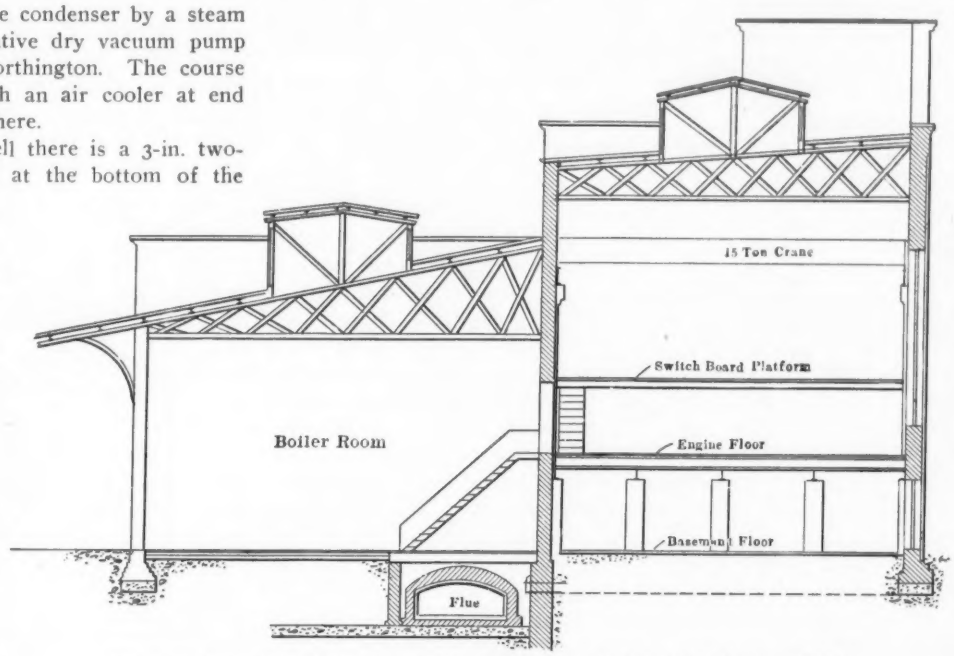


FIG. 9.—CROSS-SECTIONAL ELEVATION THROUGH ENGINE AND BOILER ROOMS.

FUEL OIL.

The station is now burning exclusively a good grade of Texas oil as fuel under the boilers. The oil is received in oil tank cars from which it is unloaded by gravity into storage tanks, of which there are three, each with 1,200-gal. capacity. These tanks are housed in a brick vault outside the station. From the tanks the oil is forced directly to the burners at 40 lbs. pressure. For this purpose there are two complete oil-pumping systems, one consisting of two 3x2x3-in. Snow duplex pumps and receiving tank, and the other consisting of two 4x2x4-in. Snow duplex pumps and receiving tank. Both of these oil pumping outfits were furnished by the National Supply Company, of Chicago.

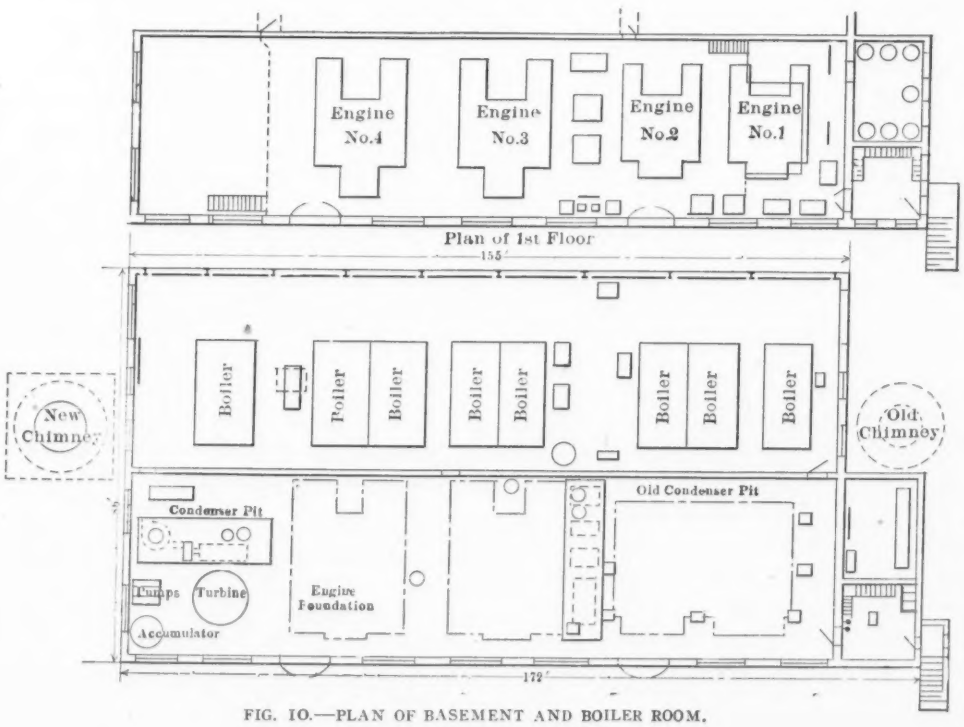


FIG. 10.—PLAN OF BASEMENT AND BOILER ROOM.

The oil burners under the boilers consist of double nozzles in which the oil as it comes through, drop by drop, is caught up by a jet of live steam which serves to thoroughly atomize the particles of oil and force them to the burners in a fine spray. The flame shoots from the end of the nozzles in a fine white flame. In this particular station provision is made for supplying the burners with superheated steam taken from a separate superheater.

The station is now using about 150 barrels of oil per day, there being 42 gal. of oil to a barrel. The total daily electrical output of the station averages about 45,000 kw-hours measured at the switchboard so that the plant is getting from 2 to 2½ kw-hours per gallon of oil. This is considered an exceptionally good showing. As a basis of comparison, it is usual to figure about 3.6 barrels of Texas oil as the equivalent in thermal units contained to one ton of Indian Territory run-of-mine coal. This is not a particularly good grade of coal. A more convenient comparison might be to say that 4 barrels of oil will equal a ton of ordinary Pittsburg coal.

The local affairs of the Houston Lighting & Power Company

are directly in charge of Mr. William H. Chapman, who has been general manager of the property for a number of years, and to whose energetic management is due in large measure the present satisfactory and efficient condition of the company. Mr. W. W. Reed is superintendent of the plant. The executive officers are Mr. A. H. Ford, of New York, president; Mr. W. H. Chapman, vice-president and general manager, and Mr. Robert Duerer, secretary and treasurer.

The Heating Effect of the Electric Spark.

By Henry A. Perkins.

FOLLOWING a suggestion of the Electrical World and Engineer made last summer, the following series of determinations on the heating produced by the electric spark has been conducted. In view of the fact that the spark method of ignition is much the most common in all forms of gas engines, it seemed desirable to find the exact quantity of heat developed under different conditions, as well as the efficiency of an average sparking apparatus as a whole, considering the heat developed by the spark as the output and the total power consumed by the coil as the input. Three series of tests were made: One set in which the spark length was varied, another in which the primary current was varied with constant spark length, and a third in which the frequency of interruption was considered the variable quantity.

The method employed was one that is readily adaptable to all similar measurements, and should be capable of a high degree

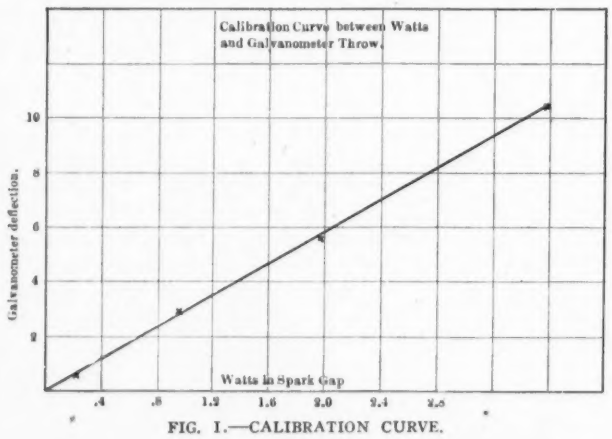


FIG. 1.—CALIBRATION CURVE.

of precision, in fact, much higher than was necessary considering the somewhat irregular character of an ordinary mechanical interruption.

The current from a battery of 30 storage cells was sent through an ordinary volume voltameter, and the primary of a Splitdorf automobile induction coil. The sparking took place inside a glass tube about half an inch inside diameter and two inches and a quarter long; the ends were stopped with corks through which passed the terminals of the secondary, ending in platinum points. The distance between these points could be varied by a micrometer whose head was outside the tube; it was thus not necessary to open the tube after the test had begun. Surrounding the spark-gap was a small, thin coil of No. 33 copper wire whose resistance was about 23 ohms. It lay close to the glass, thus leaving nearly a quarter of an inch between itself and the platinum terminals. The coil was nearly three-quarters of an inch long; it might thus be supposed to absorb a large percentage of heat from a spark that did not exceed a length of one-quarter of an inch. This test coil formed one of the arms of a Wheatstone bridge, the galvanometer being of the D'Arsonval type with a large period and damping factor.

In order to interpret the deflections of the galvanometer in terms of joules given off by the spark as heat, and absorbed by the surrounding coil, it was necessary to calibrate the whole arrangement. This was done by substituting for the spark-gap a minute spiral of bare German silver wire that could be heated by a current from some dry cells. The number of joules given out by this coil were determined by taking the time the circuit was closed and measuring the volts across the coil with a standard voltmeter, and the current with a Kelvin balance. The deflections of the galvanometer were then plotted as a function of the watts given off in the form of heat, as in Fig. 1. The time of heating in this as in all succeeding determinations was invariably ten seconds. By this method of calibration it was not necessary to make any assumptions as to the proportion of heat absorbed by the coil, or the influence of time on the transfer of heat by conduction or convection, for the conditions were exactly identical in the case of calibration and actual test, except

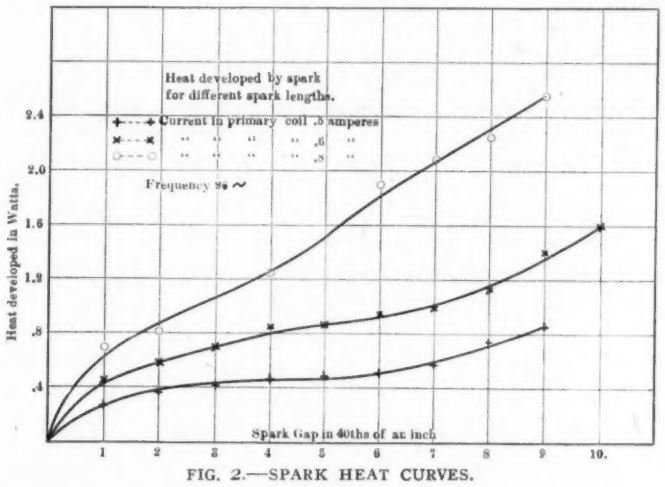


FIG. 2.—SPARK HEAT CURVES.

that the small heated spiral was replaced by a spark occupying practically the same position.

In making a determination of the heat developed by the spark the method was as follows: The bridge was balanced, and allowed to stand for a while until the heating of the test coil due to the current flowing in it was balanced by the rate of radiation. The bridge was then rebalanced and no observation was made when the cross hair of the telescope was as much as two small scale divisions from the zero of the scale and was practically in equilibrium. Next the length of the hydrogen column in the voltameter was taken, and finally the circuit closed and kept closed for ten seconds by a stop watch. For perhaps a second and a half after closing the circuit, the galvanometer remained stationary, then it began to swing, and continued for nearly the same time after the circuit had been opened again. This lag was probably due to the time required for the radiated heat to be conducted through the insulation of the test coil. The maximum deflection was then read, also the length of the hydrogen column, and the voltage of the main storage battery during the observation. The deflection could be readily reduced to joules or watts by the calibration curve, and the effective primary current calculated from the amount of hydrogen liberated.

In order to calculate the power input I made use of a set of observations with a variable number of dry cells connected directly to the primary without interposing the voltameter. The current sent through by a number of cells was estimated by comparing the heat developed with that produced by a known current under exactly the same conditions. Then taking the product of this current and the known voltage of the dry battery, a rough estimate of the power input as a function of the current was obtained. This curve was practically a straight line and was produced to give values beyond the range of the dry cells used.

Such a method is far from satisfactory as it takes no account of the undoubted lagging of this intermittent current, and there are other obvious sources of error. But no simple method for quantitative measurement of this pulsating but inharmonic power occurred to the author, that was not open to serious objection. The efficiencies quoted below must then be regarded as only suggestive of the true values.

The first set of curves, Fig. 2, show the influence of varying the length of the spark for three different primary currents.

The currents in this case being .52, .60 and .76 amp., respectively. It is evident that the heating increases with the length of the spark, but not as a simple linear function. To test the reliability of the method, one of the curves was repeated in inverse order, and the points thus obtained agreed very well with those of the first set. As an illustration of the complete series of readings, the following table may be interesting. The time in every case

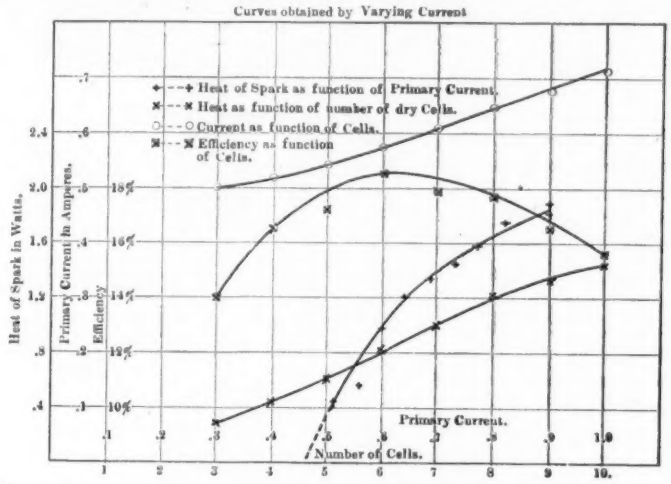

Curves obtained by Varying Current
Heat of Spark as function of Primary Current.
Heat as function of number of dry Cells.
Current as function of Cells.
Efficiency as function of Cells.
Heat of Spark in Watts.
Primary Current in Amperes.
Efficiency
Primary Current.
Number of Cells.

FIG. 3.—CURVES SHOWING EFFECT OF VARYING CURRENT.

was 10 seconds, the hydrogen liberated .6 c.c., the frequency about 96 cycles, and the impressed e.m.f. 57 volts.

Length of gap.	Deflection of galvanometer, ascending.	Deflection of galvanometer, descending.	Heat developed in watts.	Primary watts (net).
1/40 in.	.76	.8	.26	2.
2/40	1.02	1.15	.36	2.
3/40	1.25	1.25	.41	2.
4/40	1.3	1.4	.45	2.
5/40	1.47	1.46	.49	2.
6/40	1.5	1.48	.5	2.
7/40	1.7	1.7	.57	2.
8/40	2.22	2.1	.73	2.
9/40	2.48	2.43	.83	2.

The efficiency, since the input is constant, increases with the output, and the maximum value for this particular curve is .84 ÷ 2. = 42%. The maximum efficiencies of the other two curves were about 32 per cent and 23 per cent, respectively.

Referring to Fig. 3, we see how the heating depends upon the primary current. Two series of tests were made in this connection. In the first the current from the storage battery was varied by an interposed resistance drum and the currents determined as usual with the voltameter; in the second series a varying number of dry cells was used, from three to ten (less than three failed to produce a spark) and the current was estimated by comparing the deflections obtained with the previous curve, for the voltameter could not be used with so low an e.m.f.

It will be seen that the current varies almost directly as the number of cells (and therefore with the e.m.f.), the heat developed increases with greatest rapidity at about six cells and there is consequently a maximum of efficiency at this point of nearly 18 per cent. In all these curves the spark gap was 5/40 in.; hence the efficiency is not as high as the values for longer sparks.

The curve of heat developed as a function of primary current is interesting as it clearly intersects the X axis at a point well to the right of the origin. This is to be expected, as it takes a current somewhere between that supplied by two and three cells to produce a spark at all.

The fourth plate is less reliable than the others, as it was very difficult to measure the frequency and keep it constant during a run, moreover the primary current varies to a very marked degree with the frequency. The method used was a rough one, simply comparing the note emitted by the vibrator with a standard tuning fork and the interval estimated. It will be seen that the points do not lie on the curves at all satisfactorily; still a rough estimate of the influence of frequency can be obtained and shows an increase of heat with decrease of period, while the power input increases much less rapidly, showing a great gain in efficiency for high notes. This conclusion is most important for the maximum efficiency obtained in this series was for a frequency of 128, the value being 16 per cent with a spark-gap only 5/40 in. long.

A few obvious conclusions may be drawn from these tests. It is evident that the heat developed by the spark increases with its length in such a manner as to suggest an actual rise in temperature as the spark length increases. The efficiency increases in the same proportion, and it would thus appear that in a gas engine the gap between the points of the spark plug should be as long as possible and still permit the spark to jump during the highest pressure used in the compression stroke. The same is true of frequency, high frequencies being both more effective and more efficient than low ones. In considering the voltage, or number of cells that should be used, we are confronted with a slightly different problem; here there appears to be a point of maximum efficiency corresponding to an e.m.f. of about 8 volts (6 cells). This, of course, depends upon the coil used, but in principle it would be the same for all coils; that is, that there is a certain critical voltage that should give the highest efficiency.

Perhaps the most important result obtained is the proof of the wastefulness of the whole process. When we consider that the process of converting electricity into heat is 100 per cent efficient, it seems extraordinary that an attempt to localize this process in a particular place means a sacrifice of perhaps 75 per cent which is lost in heating the other parts of the circuit. Of course the temperature necessary for ignition is very high and it may be that no better way can be devised for securing this temperature quickly and surely, and that the process is subject to the same kind of limitation that restricts the use of the inverted refrigerating machine, where higher temperatures are produced with lower and lower efficiency.

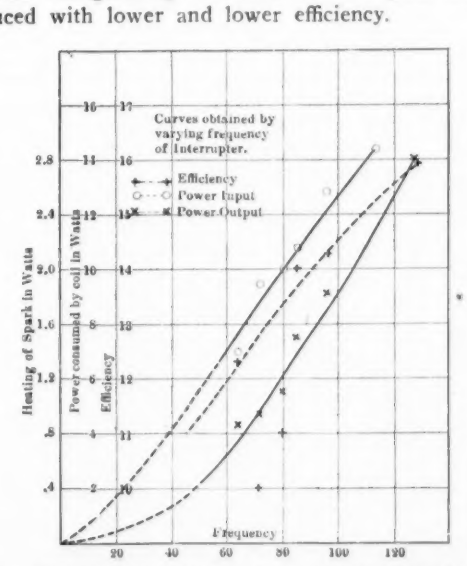


FIG. 4.—CURVES SHOWING EFFECT OF VARYING FREQUENCY.

Those who are familiar with the gas engine in the automobile are aware of the surprising rapidity with which even large dry cells are exhausted, and any adjustment that will even double their life should be a welcome one, but it seems doubtful if much more than that can be secured when the secondary spark is the device used for ignition.

Applied Science at Harvard.

As a preliminary measure in the utilization of the McKay millions left to Harvard for the advancement of the study of applied sciences, the governing bodies of Harvard have established a Graduate School of Applied Sciences and a new general degree of bachelor of sciences. For admission to the new school a bachelor's degree will be required. The course of study will be ordinarily two years. Degrees in applied science from Harvard will in future be of the same standard as degrees from the Harvard law, medical and divinity schools.

Circle Diagram of Compensated Series Single-Phase Motor.

By E. C. Stone.

If an alternating current be passed through an ordinary direct-current series motor, rotation is produced, for the flux and current reverse at the same time, thus maintaining torque in the same direction. This torque, however, instead of being steady, as in the direct-current case, is pulsating on account of the alternations of current and flux.

Now if an armature of the ordinary direct-current type be rotated in an alternating field (see Fig. 1) two e.m.f's will be

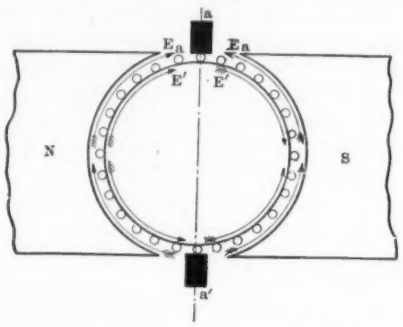


FIG. 1.—SIMPLE TWO-POLE MODEL OF SERIES MOTOR.

generated in the conductors. Let us assume that the brushes are at the neutral points, $a\,a'$ (Fig. 1).

1. The ordinary e.m.f. of rotation, Ea, familiar in the direct-current motor. Its direction is shown by the arrows *outside* the armature,

$$Ea = \frac{\phi m}{\sqrt{2}} Na\, n \times 10^{-8}, \qquad (1)$$

where ϕm = maximum flux crossing air-gap,
Na = conductors on armature,
n = speed, in revolutions per second.
Ea = r.m.s. value of voltage..

2. An e.m.f., E', which is caused by the alternating flux, and is exactly analogous to that produced in the secondary of a transformer. It is represented by the arrows inside the armature, Fig. 1. Its equation is the same as the transformer equation:

$$E' = 2\pi f \cdot \frac{\phi m}{\sqrt{2}} \cdot \frac{2}{\pi} \cdot \frac{Na}{2} \cdot 10^{-8},$$

$$= 4.44 \cdot \frac{2}{\pi} \cdot \phi m \cdot \frac{Na}{2} \cdot f \cdot 10^{-8}, \qquad (2)$$

where f = frequency cycles per second.

N_a being the number of conductors on the armature, $\frac{Na}{2}$ = the number of turns. The factor, $\frac{2}{\pi}$, comes in because the number of lines of force linked with a single turn depends upon the position of the coil, and is proportional to $sin\ a$ (Fig. 2). The

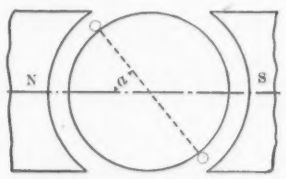


FIG. 2.—DIAGRAM FOR DETERMINING THE INTERLINKAGE OF FLUX AND TURNS.

flux linked with any one turn = $\phi m\ sin\ a$, and the total flux linked with the armature turns = $\phi_m \int_0^{\pi} sin\ a\ d\ a = 2\phi_m$. Therefore, the average value of the maximum flux linked with a conductor = $\frac{2}{\pi}\ \phi m$.

In this type of motor the brushes are placed at the neutral points ($a\,a'$, Fig. 1) with respect to Ea, so that E', consisting at these points of two equal and opposite components, does not manifest itself at the terminals of the motor. It does, however, appear in the coils short-circuited by the brushes. With the brushes thus placed the coil under the brush being at right angles to the field links with practically all the main flux, which causes a considerable e.m.f., Es, to be set up therein.

$$Es = 2\pi f \cdot \frac{\phi m}{\sqrt{2}} \cdot Ns \cdot 10^{-8}. \qquad (3)$$

Ns = number of *turns* short-circuited by each brush.

This e.m.f. produces a short-circuit current which causes trouble in two ways:

1. Sparking at the commutator, due to breaking of current when brush leaves short-circuited coil.

2. I^2R losses and attendant heating.

Hence, the number of turns, Ns, that are short-circuited should be kept as small as possible, in order to keep down the induced voltage and consequent short-circuited current. Also, resistance is introduced into the commutator leads to keep down the short-circuit current.

Now, suppose a current I to flow through the motor. As field coils and armature are in series, the current is identical throughout the motor. This alternating current, I, in the field winding produces the main flux, ϕf, which is somewhat larger than ϕ, the flux across the gap, on account of the leakage directly from pole to pole. This alternating flux sets up a back e.m.f., Ef', 90° behind it in phase.

$$Ef' = 2\pi f \cdot \frac{\phi fm}{\sqrt{2}} \cdot Nf \cdot 10^{-8}, \qquad (4)$$

where ϕfm = maximum field flux,
Nf = number of field turns.

If current I were a pure magnetizing current, it would be in phase with ϕf. But it must also supply a power component at right angles to ϕf, sufficient to cover not only the core loss in the field structure, which is laminated, but also the copper losses in the short-circuited coil.

To understand that the latter loss is supplied in this way, simply consider the short-circuited coil as the secondary of a transformer, whose primary is the main field coil. The e.m.f. set up in the short-circuited coil is of course 90 electrical time degrees from ϕf and the power component, Is, of the short-circuit current is in phase with the e.m.f. Hence Is is at right angles to ϕf, and consequently to the magnetizing current.

If I_p = power component and I_m the magnetizing component,

$$\mathrm{I} = \sqrt{I_m^2 + I_p^2}. \qquad (5)$$

The angle of phase difference $\beta = tan^{-1} \frac{I_p}{I_m}$.

Due to the rotation through the flux, the counter e.m.f. of the motor is set up according to (1). This is in time phase with the main flux, since it arises from cutting that flux. With alternating current the armature winding becomes a choke coil, the flux set up being parallel to a line joining the brushes. A back e.m.f. is thus produced, displaced 90 time degrees from the armature current, such that

$$Ea' = 2\pi f \cdot \frac{\phi am}{\sqrt{2}} \cdot \frac{2}{\pi} \cdot \frac{Na}{2} \cdot 10^{-8}, \qquad (6)$$

where ϕam = maximum armature flux. $\frac{2}{\pi}$ comes in here for the same reason as in (2), save that here the flux linkage is proportional to $cos\ a$.

This flux, whose direction is 90 electrical space degrees from the main flux, serves no useful purpose; it merely lowers the power factor of the motor, since Ea is displaced nearly 90° in phase from the main current. This flux is, therefore, counteracted by current in a compensating coil which is wound in slots in the

poles, and is given a number of turns such that the current will set up a field as nearly as possible equal to ϕa, but opposite in direction, thus neutralizing the armature inductance, and making it practically = 0. The compensating winding is in series with armature and field coils, as shown in Fig. 3.

There will be, however, still some local flux around the armature conductors, which will not link with the flux of the compensating winding and vice versa. This gives rise to some leakage reactance in these windings which is quite analogous to the leakage reactance of induction motors.

The equation for torque in the single-phase motor is the same as in the direct-current case, save that the angle β between current and flux, due to the losses mentioned above, must be taken into consideration. The torque in dynes may be expressed as

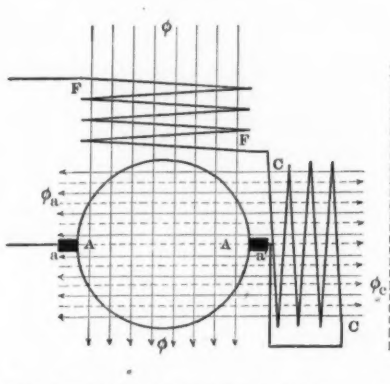


FIG. 3.—DIAGRAM SHOWING COMPONENT FLUXES IN COMPENSATED SERIES MOTOR.

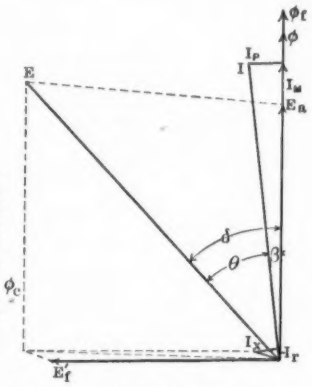


FIG. 4.—VECTOR DIAGRAM FOR FULL LOAD.

$$Td = \frac{\frac{I}{10} \cdot \frac{\phi m}{\sqrt{2}} \cdot Na}{2\pi} \cos \beta, \qquad (7)$$

where I = effective value of the current in amperes,
ϕm = maximum flux across the gap,
Na = conductors on armature.
Reduced to lbs.-ft.,

$$T = \frac{I\ \phi m\ Na}{2\pi\sqrt{2}} \cos \beta \times .737 \times 10^{-8}. \qquad (8)$$

This is, of course, the formula for electrical torque, from which the torque demanded by armature core losses due to rotation, and also by friction, must be supplied.

$Cos\,\beta$ is determined by the core losses in the field structure and by the I^2R losses in the short-circuited coils. These losses are proportional to I^2—hysteresis only approximately, of course—if the main flux is proportional to the main current, which is true so long as the saturation curve is a straight line. This is nearly true here, since low flux densities must be used; and the angle β is practically constant.

The following table gives an analysis of the power consumed by the motor:

Power Input
- Electrical Losses
  - Core losses in field structure, due to alternating current.
  - I^2R losses in windings.
  - I^2R losses in short-circuited coils.
- Mechanical Power
  - Core losses in armature, due to rotation.
  - Useful mechanical work.
  - Friction.

The vector diagram for full load is given in Fig. 4. Let ϕ = flux across the gap. Then ϕf = flux that must be set up in the field coils in order to allow for leakage. To produce this flux, a magnetizing current, I_m, is necessary, while I_p at 90 electrical time degrees to I_m is consumed in losses. The main current, $I = \sqrt{I_m^2 + I_p^2}$. To overcome the back e.m.f. due to the alternating flux, ϕf, a component, Ef, at 90 electrical time degrees to ϕf must be supplied. The back e.m.f. of rotation is nearly in opposition to the current, I—since it must be in phase with ϕ, but opposed to the current—and a component of e.m.f. of opposite direction must be supplied to overcome it—Ea. I_r in phase with I, and I_x in quadrature to I, represent the components of voltage supplying, respectively, the resistance and reactance drops of the motor. x = leakage reactance of armature and compensating windings; r = total resistance of the motor. The vectorial sum of Ef', Ea, I_r and I_x gives E, the terminal e.m.f. of the motor. The cosine of angle Θ is the power factor. Angle β = angle between I and ϕ, produced by the power component of I supplying losses in field and short-circuited coils.

An excellent circle diagram for this type of motor was given by Mr. F. Creedy, in the London *Electrician* for April 21, 1905. This diagram assumes that the machine has a straight line saturation curve, which is very nearly true within the working range of most motors of this kind, since the flux densities must be low to keep down the iron losses. If this is the case, the angle β will be constant, as mentioned previously.

A constant e.m.f., $O\,E_0$ (Fig. 5) is impressed. At standstill the motor is merely a choke coil, and the current flowing, $O\,S$, will be such that the vectorial sum of resistance and reactance drops equals the impressed e.m.f. As the motor starts a counter e.m.f., $O\,E'$, is set up in phase with the flux and at the angle $\pi - \beta$ to the main current, $O\,I$, which produces a current $O\,I'$, lagging behind it at a constant angle, $I'O\,E'$, which represents the impedance of the motor. The main current, $O\,I$, is equal to the vector difference between the short-circuit current, $O\,S$, and this current, $O\,I' = S\,I$. Since the angle $I'O\,E'$ is constant, and therefore angle $S\,I\,O$ is constant, and $O\,S = O\,I + S\,I$ vectorially, the extremity of $O\,I$ must be the locus of a circle passing through O.

FIG. 5.—CIRCLE DIAGRAM OF COMPENSATED SERIES MOTOR.

Now, $O\,I'$ is parallel to $S\,I$ by construction.

$\therefore\ < S\,I\,O = < I\,O\,I'$.

Also $< S\,O\,E_0 = < E'O\,I'$, both being the angle of impedance of the motor.

$< \beta$ = angle between ϕ and I, the main current.

$< E'O\,I = \pi - \beta$.

$< I\,O\,I' = \pi - \beta - S\,O\,E_0$.

$< S\,I\,O = \pi - (\beta + S\,O\,E_0) = < S\,O\,F$,

where the line $F\,G$ makes $< \beta$ with $O\,E_0$.

$\therefore$ $F\,G$ touches the circle at O.

$\therefore$ The diameter $O\,M$ of the circle makes the angle β with the line $O\,R$ of zero power factor.

Speed: $S\,I$ is proportional to the counter e.m.f., $O\,E'$.

$\therefore$ $S\,I$ " " " flux × speed.

But the flux " " " the main current, $O\,I$.

$\therefore$ $S\,I$ " " " $O\,I \times$ speed.

$$\text{and speed} = \frac{SI}{OI} \times \text{a constant.}$$

Make the angle $OSP = SIO$. Produce OI to P. Then the triangles SIO and OSP are similar

$$\text{and } \frac{SI}{OI} = \frac{SP}{SO}. \quad \text{But } SO \text{ is constant.}$$

$\therefore$ SP is proportional to speed.

Torque: Torque is proportional to OI^2 (since ϕ is proportional to I).

$$IN^2 = ON \,.\, NM.$$

Add ON^2 to both sides.

$$IN^2 + ON^2 = OI^2 = ON\ (ON + MN) = ON \times OM.$$

But OM is constant.

$\therefore$ OI^2 is proportional to ON,

and torque " " " ON.

Output: Output = torque × speed $= OI^2 \times \frac{SI}{OI} = SI \times OI.$

But angle SIO is constant.

$\therefore$ $SI \,.\, OI$ is proportional to area of triangle SIO.

The base of SIO is constant.

$\therefore\therefore$ $SI \times OI$ is proportional to the altitude IH of triangle SIO.

$\therefore$ Output is proportional to IH.

Power Factor: With center O and radius = 1, draw a circle cutting OE_0 and OI at a and b, respectively. Then, obviously, OK = power factor.

Efficiency: Output is proportional to IH.

Input " " " IR, since IR = component of current, OI, in phase with e.m.f., OE_0.

$$\text{Efficiency} = \frac{IH}{IR}.$$

Iron Losses in Single-Phase Commutator Motors.

By Prof. Dr. F. Niethammer.

IT is a well-known fact that the iron losses of a direct-current armature or of a three-phase armature are considerably larger than those in the core of a transformer, induction periodicity and volume being the same in the two cases. In the first case the magnetization is produced by rotation of an iron body in a magnetic field, and in the second case there exists a local periodical variation of the field. In a single-phase series motor both kinds of magnetizations are combined; at standstill there is only a transformer action, but after being started the armature of such a motor rotates in an alternating field. There are two widely different periodicities which have a bearing on the iron losses of a single-phase commutator motor, viz.: the periodicity, n_r, of rotation, equal to the number of revolutions per minute multiplied by the number of the poles of the motor and divided by 120. From a theoretical standpoint it is difficult to decide in which way the total iron losses depend upon these two periodicities. Steinmetz states that up to synchronous speed the iron losses of series motors depend upon n, and that above synchronism they vary with n_r, which seems entirely logical.

In order to ascertain in just what manner the iron loss varies with the speed, a simple experiment was performed using the circuits shown in Fig. 1. The field, F, of the single-phase commutator motor, K, is excited by an alternating current, A_c, and the open-circuited armature, K, is driven by an auxiliary direct-current motor, H. The watts, Ae, input to the field and the watts input to the auxiliary motor were measured once when F was not excited (A_1) and then when F had a definite alternating-current excitation (A_2). The test conditions corresponded to those found in compensated series motors. The difference, $A_m = A_2 - A_1$, of the last two values gives the watts iron loss supplied to K by the auxiliary motor, H (if all necessary precautions are taken), and the first-mentioned watts are the iron losses supplied by the alternating current in the field coils. The sum of the two values, $A_e + A_m$, gives the total iron losses.

The motor tested was a four-pole machine with an output of 7 hp at 1,500 r.p.m. It is constructed with an equally distributed series winding in stator and rotor covering the whole circumference (no definite poles). The measurements were made at speeds from zero up to 1,800 r.p.m. for two periodicities, 35 and 50, and for two magnetic fields equal to about the full-load field

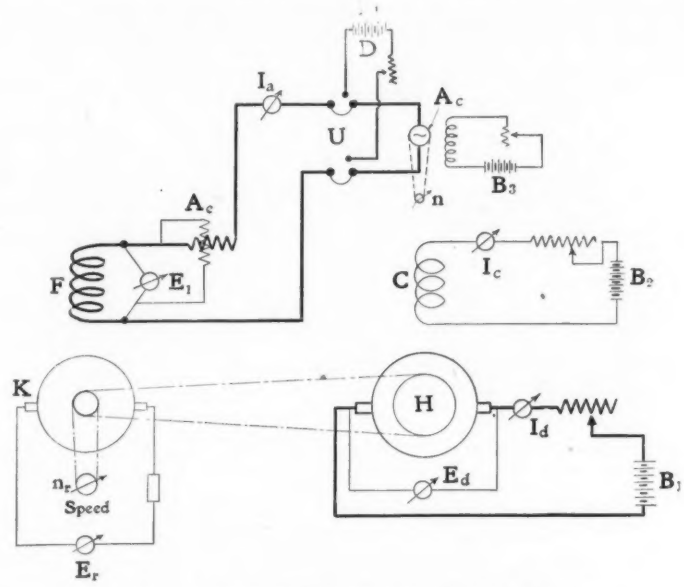


FIG. 1.—ARRANGEMENT OF TESTING CIRCUITS.

and about half of this value. The value of the armature field, F_a, was determined from the open e.m.f., E, of the armature, R, and that of the primary field, F_f, from the field voltage, E. All necessary corrections were made on the measured results of the commutator motor, K, as well as on those of the auxiliary motor, H.

For purpose of comparison the iron losses with direct-current excitation were also measured by changing the position of the reversing switch, U, on D. The results are shown in Figs. 2

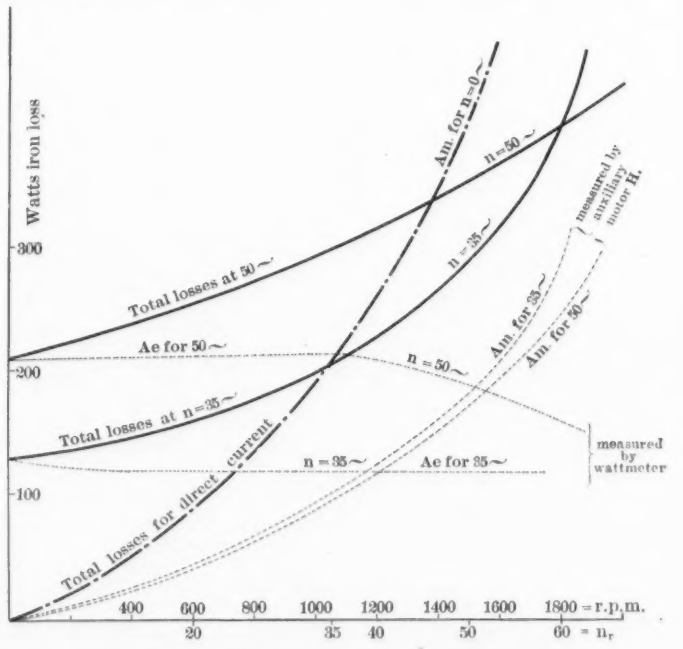


FIG. 2.—IRON LOSSES OF SINGLE-PHASE MOTOR.

and 3; Fig. 2 for the larger flux and Fig. 3 for the smaller flux. The curves in full line refer to the total losses, which are made up of the two dotted curves which represent singly the losses measured by the wattmeter, A_c, and by the auxiliary motor, A_m. The dot-and-dash curve refers to direct current. For small

speeds the total iron losses are the smallest for low periodicities, but for high speeds the ratio is reversed and the losses are largest for low periodicities. In fact, the curves for 35 periods crosses the curve for 50 periods, and the curve representing the direct-current losses crosses, first, the curve for 35 periods, and later on the curve for 50 periods, the flux remaining constant.

A knowledge of the character of these curves should be of value in connection with single-phase motors used for intermittent

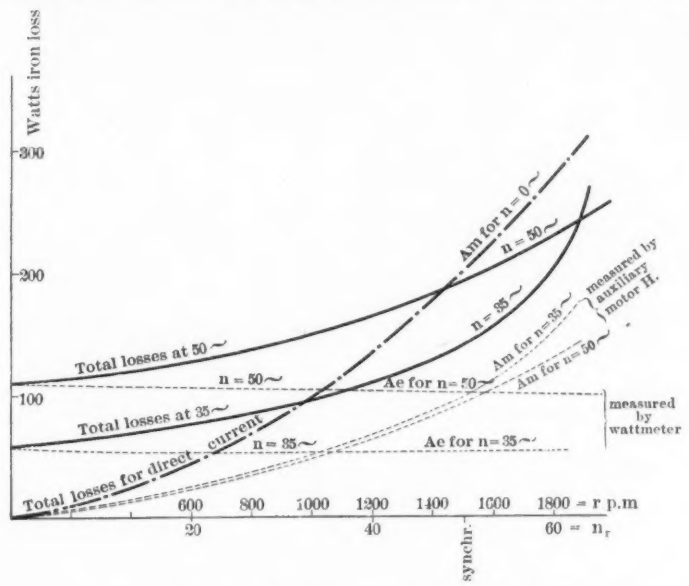


FIG. 3.—IRON LOSSES OF SINGLE-PHASE MOTOR.

work where starting and stopping occur frequently, for example, for traction purposes on urban lines. It may be noticed that in this special case the intersection of the direct-current curve with the alternating-current curves takes place in the neighborhood of the synchronous speed; that is, at a point where n_r is nearly equal to n.

The curves may be expressed approximately in formulas similar to those used for the iron losses in transformers and dynamos, as follows:

Hysteresis in the field (stator):

$$\sigma \left(\frac{n}{100}\right)\left[\left(\frac{\mathfrak{B}_1}{1{,}000}\right)^{1.6} Vs + \left(\frac{\mathfrak{B}_{Z_1}}{1{,}000}\right)^{1.6} Vzs\right] \quad (1)$$

Eddy currents in the field (stator):

$$c\,d^2 \left(\frac{n}{100}\right)^2\left[\left(\frac{\mathfrak{B}_1}{1{,}000}\right)^{2} Vs + \left(\frac{\mathfrak{B}_{Z_1}}{1{,}000}\right)^{2} Vzs\right] \quad (2)$$

Hysteresis in the armature (rotor):

$$\left[\sigma \left(\frac{n}{100}\right) + \sigma^1 \left(\frac{nr}{100}\right)(1 - b\,n)\right] \left[\left(\frac{\mathfrak{B}_2}{1{,}000}\right)^{1.6} Vr + \left(\frac{\mathfrak{B}_{Z_2}}{1{,}000}\right)^{1.6} Vzr\right] \quad (3)$$

Eddy current in the armature (rotor):

$$d^2\left[c\left(\frac{n}{100}\right)^2 + c^1\left(\frac{nr}{100}\right)^2\left(1 - b\,n\right)^2\right] \left[\left(\frac{\mathfrak{B}_2}{1{,}000}\right)^{2} Vr + \left(\frac{\mathfrak{B}_{Z_2}}{1{,}000}\right)^{2} Vzr\right] \quad (4)$$

In the above formulas, n = periodicity of impressed e.m.f., n_r = periodicity of rotation. $\mathfrak{B}_1$ (magnetic density) in stator core per square centimeter, $\mathfrak{B}_2$ magnetic density in rotor core, $\mathfrak{B}_{Z_1}$ = flux density in stator teeth, $\mathfrak{B}_{Z_2}$ = flux density in rotor teeth, Vs = volume of stator core iron in cubic decimeter, Vr = volume of iron of rotor core, Vzs and Vzr = volume of teeth in stator and rotor, d = thickness of iron sheets in millimeters. For the motor under test the coefficients are approximately $\sigma = \sigma' = 1$; $c = 2$; $c' = 20$; $b = .011$. The high value of c' proves the well-known fact that in an armature rotating in magnetic fields large additional eddy currents occur.

Unfortunately, there is no similar experimental method for determining the iron losses of the repulsion motor or of the series motor with transverse (short-circuited) brushes. So far as theory goes, one may conclude that the stator iron losses of repulsion motors will be the same as for the simple series motor with damping coil, given in (1) and (2), but for the rotor the losses are different, viz.:

Hysteresis in the armature (rotor):

$$\left[\sigma \left(\frac{n_s}{100}\right) + \sigma^1 \left(\frac{nr}{100}\right)\right] \left[\left(\frac{\mathfrak{B}_2}{1{,}000}\right)^{1.6} Vr + \left(\frac{\mathfrak{B}_{Z_2}}{1{,}000}\right)^{1.6} Vzr\right] \quad (5)$$

Eddy currents in the armature (rotor):

$$d^2\left[c\left(\frac{n_s}{100}\right)^2 + c^1\left(\frac{nr}{100}\right)\right] \left[\left(\frac{\mathfrak{B}_2}{1{,}000}\right)^{2} Vr + \left(\frac{\mathfrak{B}_{Z_2}}{1{,}000}\right)^{2} Vzr\right] \quad (6)$$

All denominations remain the same as for the expressions (1) to (4), n_s = slip = $n - n_r$ (always to be used as a positive value). In this equation the parts containing n represent the additional eddy-current losses.

Economy of Power in the Electroplating Room.

BY A. J. TIZLEY.

It is unfortunately true that less attention is given to the electrical equipment in the majority of electroplating rooms attached to manufacturing plants than to the apparatus employed in other departments of no greater importance. Upon looking over an electroplating room recently installed in a large plant, the following conditions were noted:

Four large tanks for acid copper plating were connected to a 1,500-amp., 3½-volt dynamo, driven by a 25-hp motor through a series of three short, heavy, tight belts. Now, to commence with, an acid copper bath designed to produce a heavy, pliable coating of copper does not require, and in fact cannot be run at, a greater pressure than 2 volts. This fact every plater should know. Investigation showed that this difficulty had been overcome by introducing a heavy rheostat into the main line cutting the voltage from 3½ volts down to 2 volts, thereby lessening the available energy distributed to the tanks in direct proportion to the reduction in pressure, the difference being lost in the resistance.

Furthermore, it was found that the conducting rods leading from the main rods to the tanks were too small in diameter; this was readily shown by the rods being so hot as to blister one's fingers. This meant a further loss of electrical energy, due to the resistance of the inadequate conducting rods.

Taking up the matter of motive power, it is evident that whereas a 25-hp motor was used to drive this 5.2-kw generator, a 7-hp motor properly installed was all that was necessary. The variation in the speed of motive power and consequent drop in voltage of the generator is compensated by the field rheostat of the modern plating dynamo.

Further examination showed that as much power was lost in transmission, between the motor and dynamo, as was consumed by the dynamo itself, due to the three belts referred to. Still further, it developed that the local Edison Company supplied this plant with about 100 hp to run its various motors and the question arose, why was it necessary to transmit power through

three belts from motor to dynamo when a direct-connected machine might have been installed at a less cost, thus eliminating the initial expense of shafting, hangers, pulleys, belts, etc.?

It has been demonstrated that under average conditions there is a loss of about 25 per cent of power in shops belt-driven from a common center, aside from the cost of maintenance, which for belting alone amounts to 37 per cent per year of the initial cost, besides other expenses; whereas with a direct-connected machine the loss of efficiency is not over 15 per cent.

In consequence of the above, the owners were advised to discard these machines and to put in a dynamo, direct-connected to a 5-hp motor; that the dynamo should have a voltage of 2½ instead of 3½ volts, and to put up conducting rods heavy enough to carry the electric current without undue heating, and consequent loss of energy. This suggestion was followed, the results being that more metal was deposited in the tanks in a given time, and the bill for electric power was reduced by nearly 65 per cent.

In another shop visited was a dynamo with an outfit of 2,500 amp. and 6 volts connected to a number of large tanks; each tank had a heavy rheostat to reduce the pressure down to from 6 volts to between 1½ and 2½ volts pressure. The power supplied was, therefore, $2{,}500 \times 6 \div 746 = 20.1$ hp. The remedy in this case was simple; the speed of the dynamo was reduced to such an extent that it registered a pressure of 2½ volts, the current remained the same, and the saving in power is readily seen if we figure as before thus: $2{,}500 \times 2\frac{1}{2} \div 746 = 8.3$ hp, being a saving of nearly 12 hp.

The above illustrations are but two of the many instances noted by the writer within the past year, and serve to illustrate how a very little forethought may appreciably lessen the expense of power in an electroplating plant.

International Conference on Electrical Units.

As was noted in our columns at the time, an international conference on the subject of the fundamental electrical units was held in Charlottenberg (Berlin), Germany in October, 1905. The conference, whose membership is noted below, was convened upon invitation of Dr. Warburg, president of the Physikalisch-Technischen Reichsanstalt, whose action was supported by Dr. Stratton, Director of the Bureau of Standards at Washington. Such a conference had been recommended by the Chamber of Delegates of the International Electrical Congress of St. Louis, and had also been advocated by the American Institute of Electrical Engineers.

At the Charlottenberg conference there were present Prof. H. S. Carhart, from the United States; Prof. E. Gerard and M. P. Clement, from Belgium; Dr. Th. Lewald, Prof. Dr. F. Kohlrausch, Prof. Dr. E. Warburg, Prof. Dr. E. Hagen, Prof. Dr. W. Jaeger, and Prof. Dr. St. Lindeck, from Germany; Dr. R. T. Glazebrook, from England; M. E. Mascart, from France; Mr. V. von Lang and Dr. L. Kusminsky, from Austria. The conference held five meetings, during which the following problems were discussed: Shall the three units: ohm, ampere and volt, be independent of each other; or, shall only two be defined, and which two? The determination of the electrochemical equivalent of silver with reference to the definition of the ampere. Selection of a standard cell. The determination of the ohm. The method of the precipitation in the silver voltmeter. The production of the standard cell. International specifications of the standard cell.

At the first meeting, which was held on October 23, a sub-committee consisting of Gerard, Glazebrook, Jaeger and Lindeck, was appointed to submit a specification of the standard ohm. The members then entered into a discussion concerning the selection of the fundamental units. Glazebrook stated that the Electrical Standards Committee of the British Association, consisting of Lord Rayleigh, Carey Foster, Ayrton, Trotter and himself, had come to the conclusion that there should be selected only two units, the ohm and the ampere, independently defined. Mascart remarked that it was unnecessary to give a theoretical definition to the units. The ohm can be defined by the column of mercury and the ampere by the deposit of silver, and from these the volt can be derived. Kohlrausch held that it was not important whether the theoretical definition was given or not. Carhart presented a paper (reprinted below) showing why the ohm and the volt should be selected as the independent units. A similar position was also taken by the Bureau of Standards in a communication, an abstract of which is printed below. The selection finally rested on the ohm and the ampere as independently defined units.

The electrochemical equivalent of silver was discussed by Glazebrook, Mascart, Warburg, Kohlrausch and Gerard. Glazebrook expressed the wish that the value 1.118 might be chosen, for this is in use in England and America. The further discussion of this point was postponed until after the silver voltameter had been dealt with. The subsequent meetings were devoted to a detailed discussion of the deposit in the silver voltameter, the specification of the ohm, the methods of eliminating the difficulties in using a column of mercury, the practical operation of the silver voltameter and the characteristic features of the cadmium cell. The final decisions of the conference were as follows:

FORMAL DECISIONS.

Fundamental Units.

That only two electrical units shall be chosen as fundamental units.

The international ohm, defined by the resistance of a column of mercury, and the international ampere, defined by the deposition of silver, are to be taken as the fundamental electrical units.

The international volt is that electromotive force which produces an electric current of one international ampere in a conductor whose resistance is one international ohm.

Standard Cell.

The Weston cadmium cell shall be adopted as the standard cell.

Determination of the Ohm.

The conference recommended the following procedure for the establishment of the ohm:

The method which omits the end correction (Ausbreitungswiderstand) should not be employed.

The Reichsanstalt will put itself in communication with Messrs. Schott & Co., of Jena, in order to determine whether tubes of glass 59 of sufficiently uniform section can be produced.

The glass tubes used in setting up mercury resistances are to be carefully annealed.

The tubes are to be filled in vacuum without heating.

In determining the weight, the mercury column is to be bounded by planes at the terminal cross-sections of the tube and to be at a temperature of 0° C.

The length measurements are to be made as far as possible at 0° C. with the aid of contact pieces.

The electrical measurements are to be carried out at 0° C. and a method is to be employed which avoids the use of thick connecting wires. Among such methods the Kohlrausch differential galvanometer method, the Thomson double-bridge method and the compensation method are recommended. The current employed in measurement shall be limited by the condition that the mercury shall not be warmed sufficiently to produce appreciable error.

The mean of at least three fillings shall be taken as the value of the resistance of a tube.

The mean of at least five tubes must be taken to determine the value of the mercury unit.

The mercury standards shall have a resistance of approximately one ohm.

For the value of the wire standard, the mean of at least five resistances of one ohm shall be taken.

A comparison of the wire standard with the mercury units shall be carried out at appropriate intervals of time.

Specification of Standard Cell.

The Weston standard cell shall contain solid hydrated cadmium sulphate; the strength of the cadmium amalgam shall be 12 to 13 per cent of cadmium.

In the form of standard cell to be finally specified, sources of disturbance at the negative pole are to be avoided.

Determination of Ampere.

The conference further expressed the following opinions:

That the information before it is not sufficient to enable it to propose any alternation in the formerly accepted value for the ampere.

That the information before it is not sufficient to enable it to lay down exact directions in respect to the silver voltameter and the standard cell.

That if a proposal for a change in the accepted value of the ampere is to be brought from any source before a formal congress to be held later, an agreement in writing on the point should be arrived at previously between the parties interested. If differences of opinion in the matter cannot be removed, another preliminary conference should be held.

The same procedure should be observed in regard to the specification for the silver voltameter and the standard cell, in the event of such specifications being submitted to a formal conference from any quarter.

International Convention.

The conference expressed the wish that an International Convention should be summoned in order to arrive at agreement in the electric standards which are in use in the different countries, and the following resolution was further adopted:

"In view of the fact that the laws of the different countries in relation to electrical units are not in complete agreement, the conference should be summoned in the course of a year with the object of bringing about this agreement."

AMPERE OF VOLT.

Following is the communication presented by Prof. H. S. Carhart:

The most important question to be discussed at this conference is the following: Shall the ohm and the ampere, or the ohm and the volt be defined for practical purposes by *concrete* standards? It will be assumed in these remarks that the usual c.g.s. definitions of the ohm, the ampere and the volt are accepted by all. We are thus in possession of ideal values, and all concrete or material standards must be critically examined with respect to these ideal values.

It will be assumed, further, that the ohm as defined by the resistance of a specific thread of mercury under standard conditions is acceptable to all as the material standard of that unit. There remains the decision between the ampere as defined by the silver voltameter and the volt as defined by means of a standard cell.

Material Standards.

The ampere cannot be represented in a concrete or material form in the sense in which the ohm and the volt can be so represented. A standard ohm can be preserved, transported and compared with other standard ohms by well-known methods. An almost identical statement may be made respecting the volt as determined by a standard cell. When one is in possession of these two standards, one is fully prepared, by means of the appropriate apparatus, to measure resistances, electromotive forces and currents, and not merely average values of the last but instantaneous values. On the other hand, an ampere, with which to compare currents and measure volts, cannot be carried about and set up as a concrete standard of comparison. The very nature of the volt, therefore, as a static electric pressure, gives it a very important advantage over the ampere from the point of view of concrete material representation. Amperes cannot be compared; volts can readily be compared.

The Voltameter not an Ammeter.

The silver voltameter is not an ammeter but a *coulometer*. It does not measure the value of a current at any instant; but it measures more or less perfectly the quantity of electricity that has passed in an observed period of time. The value of the current derived from it is only the mean arithmetical value of a current which varies more or less throughout the period included in the observation. It has its scientific uses, but it is an imperfect device to employ for the legal definition of an ampere.

The Chemistry of the Silver Coulometer not Understood.

It has been shown within the last few years that the electrochemical equivalent of silver may apparently be made to vary as much as two-tenths per cent. The variation appears to be due in large part to the formation at the anode of some modification of silver nitrate, in which the silver has a larger electrochemical equivalent than the silver of the normal nitrate. If this compound reaches the cathode, the deposit of silver is greater than for a normal solution. The best suggestion made thus far in this connection is to adopt some means of keeping the unknown compound away from the cathode; but such a solution of the difficulty may or may not be a perfect one. This serious objection is sufficient in itself to decide in favor of the abandonment of the silver coulometer for the purpose of legally and scientifically defining the ampere.

Its Limitations.

The silver coulometer hitherto has been restricted to currents not much in excess of one ampere. Hence for practical purposes in calibrations it is nearly worthless. If it were not imperfect otherwise, the only service it can perform is to integrate the record of an ampere balance and to transfer this record imperfectly to a potentiometer for the purpose of determining the electromotive force of a standard cell. But the standard cell itself is capable of recording, in connection with a standard resistance, the instantaneous indication of an ampere balance. This cannot be done by the silver coulometer.

Currents Measured Practically by Standard Cell.

Even though the ampere should be legally defined by means of the silver coulometer, practical calibrations for both legal and scientific purposes would not be made by the silver coulometer, but by a standard resistance and a standard cell. This practice would lead to two values of the ampere, which might or might not agree. It is eminently wiser and more scientific to preserve the indications of an absolute ampere balance by means of a standard cell and a standard resistance than to endeavor to preserve them by a silver coulometer.

Relation of the Ampere Balance to the Question.

In the last analysis the ampere, in whatever way it may be defined for practical purposes, must be determined by means of an absolute electrodynamometer or ampere balance. Such a piece of mechanism cannot itself be employed to *define* the ampere for general practical purposes. It cannot be precisely duplicated; its indications may involve the constant of gravity; and no one instrument should be relied upon in the final decision. The real question now is whether the results obtained by such instruments shall be given to the world in the form of the electrochemical equivalent of silver, or in the form of the electromotive force of a standard cell.

The advocates of the silver voltameter urge that the ampere should be legally defined by means of it, and that the volt should follow from the ohm and the ampere by Ohm's law. This can mean only that the electromotive force adopted for any standard cell must be determined by means of a standard resistance and the silver coulometer; *otherwise* the definition of the ampere by the silver coulometer would have little or no significance. But the electromotive force of a standard cell can be determined more easily and more reliably, with higher precision, and therefore more scientifically by the use of a standard resistance and the ampere balance, than by a standard resistance and a silver coulometer. In both methods the electromotive force of a standard cell in the last analysis involves a standard resistance and the ampere balance; but if the silver coulometer is used, the indications of the absolute ampere balance are carried over to the standard cell through the imperfect agency of the silver coulometer. It is certainly more reliable and more accurate to determine the electromotive force of a standard cell directly by the use of the ampere balance and a known resistance than indirectly and circuitously through the intermediate agency of the silver coulometer. Why take so much pains to preserve consistency with the past when obviously the direct method is better?

Ohm in Ampere Twice.

The proposal to define the ampere by means of Ohm's law has been objected to on the ground that the ampere would involve the ohm twice; for the only practicable method of determining the electromotive force of a standard cell is by comparing it with the

fall of potential of a known current over a known resistance. But it should be pointed out that the electromotive force of a cell is directly proportional to a resistance, while a current by Ohm's law is *inversely* proportional to a resistance. Hence the resistance disappears and is not involved at all in the current. Thus

$$Amperes = \frac{Volts}{Ohms} = \frac{RI}{R} = I$$

is an equation expressing the operations by which the ampere for practical purposes is derived from the ampere balance. Any error in the ohm will, therefore, not affect the ampere in the least. The value of the volt will in any event be proportional to the ohm, and any correction that time may show the need of making in the legal ohm will mean the same percentage correction in the volt, but the ampere will remain unaffected.

The Weston Normal Cell.

Standard cells, and especially the Weston normal cell, have now reached such an approach to perfection that their reproducibility may be relied upon to about one hundredth per cent. Their electromotive force can be determined with all the accuracy with which the ampere can be determined by an absolute ampere balance. The Weston normal cell as now constructed leaves little to be desired as an instrument of precision; and the definition of the legal volt in connection with it, and of the ampere by Ohm's law, will bring the legal values of these quantities into agreement with those in practical use.

MEMORANDA FROM THE U. S. BUREAU OF STANDARDS.

The United States Bureau of Standards submitted three memoranda to the conference. One of these gave an outline of investigations that should be carried out in order to make it possible for an international congress to redefine the electrical units. The opinion was expressed that there is too much uncertainty attending the values of the standard cell and the electrochemical equivalent of silver to warrant any change at present in their legal values; and that it would be better to conduct investigations, if necessary, for three or four years, and then to select values that will stand for a generation, rather than adopt values hastily that may require modification in a few years. If possible the ohm should be redetermined by several different methods in a very thorough way, to make sure whether any change is needed in its present definition; this is the more needed as its value enters into the determination of the volt and of other electrical units.

A second memorandum submitted a proposal for new legal definitions of electrical units, intended to harmonize the two different views advocated regarding the definition of the units. The proposal is that while the definition should state that the ohm, volt and ampere are intended to have certain values in the c.g.s. system, their actual legal values will be defined by certain concrete standards, prepared in certain definite ways to be officially specified. There will thus be no ambiguity or uncertainty regarding the legal units, there will be international agreement as to their values, and yet they may be redefined and their values slightly modified (say a generation hence) if the differences between the legal values and true values prove to be sufficient to warrant it. If, on the other hand, the definition should be made in terms of the c.g.s. units, any country is at liberty at any time, independently of other countries, to order its standards and to bring them more nearly in accord with what it feels to be the true values of these units, unless concrete standards are legalized apart from the units (as has been done in England), which the memoranda states to be undesirable.

Of the three units to be defined, only two—the ohm and the volt—should be independent. If further research shall demonstrate that the silver coulometer is more reliable for precision measurements than the cadmium cell, the Bureau of Standards will be willing to reconsider this choice. A decided preference was expressed for the cadmium cell over the present standard or Clark cell.

A sub-commission to carry along the investigations indicated above should consist of representatives of Physikalischen Technische Reichsanstalt, the National Physical Laboratory of England, one of the government laboratories of France, and the United States National Bureau of Standards, not more than two members of each to be appointed by the president or director of each institution, in addition to the said president or director, and 12 other members to be selected by the present conference—in all not more than 24 members. This commission should be authorized to issue a call for an international congress when the results of investigations shall warrant it, and to make a report and recommendations to such congress concerning the subject of electrical units.

A third memorandum submitted consisted of a discussion by Dr. K. E. Guthe on the electrochemical equivalent of silver, and called attention to the need of further research to determine the value of such equivalent.

A recommendation was also made with respect to an international committee consisting of representatives from such government institutions as support well-equipped laboratories for the maintenance and study of electrical standards, which should supervise the intercomparison of standards and designate the values to be assigned to the standards of each institution as a result of such intercomparison. These intercomparisons of standards or of copies of standards would be made at the several government laboratories, and would not necessitate the establishment of a new institution. Such an international committee might also take cognizance of the standards of inductance, of capacity, of photometry and of such other standards as might seem desirable.

LETTER TO THE EDITORS.

Efficiency of Lighting Balancers.

To the Editors of Electrical World:

Sirs:—In your issue of January 13, page 115, Mr. C. T. Wilkinson shows the over-all efficiency of a balancer set to be:

$$\eta = \frac{1}{2} + \frac{I_g}{2I_m}$$

I_g and I_m being the generator and motor current, respectively.

In calculating this over-all efficiency, however, no consideration was given to the fact that the balancer set supplies its power under only half the voltage which the main generator uses, and

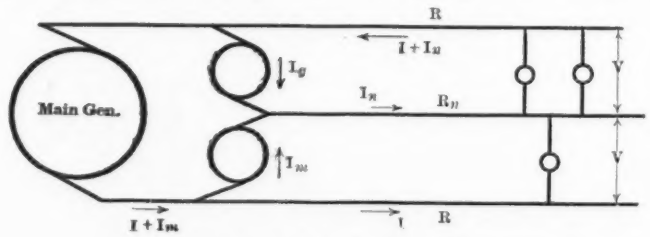


DIAGRAM OF BALANCER CIRCUITS.

that, therefore, the transmission efficiency of the power furnished by the balancer set must be lower than the transmission efficiency of the power furnished directly by the main generator. The over-all efficiency of the balancer set is, therefore, in fact lower than the above equation determines, because the balancer set in addition to the loss represented by $(1 - \eta)$ produces the reduction of potential for which it is intended.

Referring to the accompanying sketch wherein

R = resistance in positive and negative leads,

R_n = resistance in neutral,

the transmission efficiency of the power furnished directly by the main generator is:

$$\eta_m = \frac{2V \times I - 2R \times I}{2V \times I} = 1 - \frac{R}{V},$$

and the transmission efficiency of the power furnished through the balancer set:

$$\eta_B = \frac{I_n \times V - I_n (R + R_n)}{I_n \times V} = 1 - \frac{R}{V} - \frac{R_n}{V} = \eta_m - \frac{R_n}{V}.$$

The last member of this equation represents the decrease of the transmission efficiency of the balancer set as compared with that of the main generator. The over-all efficiency of the balancer set is therefore:

$$\eta_{B'} = \left(\frac{1}{2} + \frac{I_g}{2 I_m}\right)\left(\eta_m - \frac{R_n}{V}\right)$$

PITTSBURG, PA. B. F. JAKOBSEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

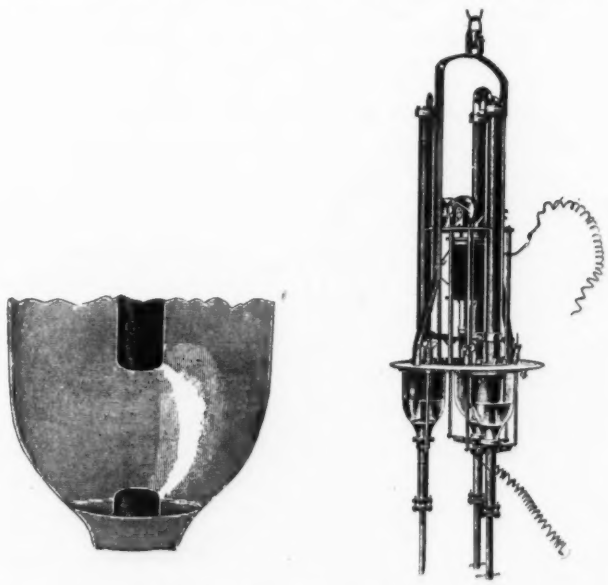
Dynamos, Motors and Transformers.

Magnetic Induction in Dynamo Armatures.—RUEDENBERG.—In designing electric machines it is important to know the path which the lines of magnetic induction take in the air-gap and in the iron, in order to determine the excitation and also because the iron losses in the moving parts depend on the density and the distribution of the lines of induction. With respect to the latter point the path taken in the armature iron is especially important and has recently been the subject of extended experiments by Thornton and Studniarski. The main point which has been established is that in the neutral zone of the armature the induction is a maximum not at the outside—as might be expected from a first approximate calculation—but further towards the center of the iron. The reason for this particular phenomenon is considered by Studniarski to be the self-demagnetizing reaction of the armature. The present author gives a mathematical theory of the subject.—*Elek. Zeit.*, February 8.

Commutation Poles.—OELSCHLAEGER, DERI AND DETTMAR.—Three letters referring to the recent article of Dettmar. They concern the history of commutation poles and some special applications like the use of commutation poles for shunt motors with adjustable speed.—*Elek. Zeit.*, February 22.

Lamps and Lighting.

Arc Lamp.—CORSEPIUS.—At the Exposition in Liege, the Vogel lamp of the Phoenix Electrical Co. was shown which represents a combination of an enclosed arc and a mercury-vapor lamp. Of the two carbons, the lower one is placed in mercury amalgam and the arc has the appearance shown in Fig. 1. The lamp shown



FIGS. 1 AND 2.—ARC LAMP.

in Liege was a triple lamp with common regulation; it is shown in Fig. 2. It furnished "considerable quantities of light" and the carbons are said to have a life of 1,600 hours. The lamps are used in connection with a starting resistance. According to the composition of the amalgam, white or colored light may be obtained.—*Elek. Zeit.*, February 8.

Waste in Incandescent Electric Lighting.—WILKINSON.—A paper read before the Leeds section of the (Brit.) Inst. Elec. Eng. The author gives some glaring instances of the use of wasteful lamps and then suggests remedies. He first suggests a law according to which the electricity undertaker would be authorized to refuse to supply a consumer who uses wasteful lamps. A second remedy which he applies in practice is to issue a lamp specification of not too exact a nature and to test lamps for contractors at a cent a piece to see that the lamps come up to their nominal candle-power and wattage. Tested lamps are stamped and consumers are advised to use only lamps so certified. (In an editorial note the objection is made that the lamp maker will soon find that he can avoid the rejection of lamps by supplying lamps of high initial efficiency and short effective life, since life tests are out of question under these conditions.) The author finally points out that the present low average efficiency of lamps is at least in some measure the result of bad-pressure regulation on the supply network which is destructive to high-efficiency lamps.—Lond. *Elec.*, February 16.

Power.

Gas Engines.—ATKINSON.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng., on the applications of gas engines to electric driving. Different methods of governing are discussed. The simplicity of "hit-and-miss" governing, together with the economical results thereby attained, make such an arrangement thoroughly satisfactory in many instances. There are cases, however, where automatic regulation has been introduced with a view to eliminating the governing variation. Broadly speaking, four methods have been adopted for this purpose, namely, throttle governing; cut-off governing; varying the richness of the charge by throttling the gas; varying the richness of the charge by admitting the gas earlier or later during the suction stroke, but cutting it off always at the same period at the end of the suction stroke. The relative merits and demerits of these different systems were dealt with. For alternating machine driving a multiple cylinder will be used. Engines giving two impulses per revolution will be mainly adopted for moderate powers, and for larger powers two such engines would be combined having their cranks at right angles.—Lond. *Elec.*, February 16.

Utilization of Blast Furnace Gases.—FREYN.—A paper giving a full and detailed estimate of the available power and of the cost of operation of a gas-engine power station operated with the waste gases from a blast furnace plant.—*Jour. Western Soc. Engineers*, February.

Steam Turbines.—A note stating that Mather and Platt are now taking up in England the manufacture of the Zoelly steam turbine of Escher, Wyss & Co. The Zoelly turbine is a multi-stage impulse turbine, with horizontal shaft, and its chief feature lies in the construction of the wheels. The same issue contains a description and results of tests of two 1,500-kw Curtis steam turbines built for a London station.—Lond. *Elec.*, March 2.

Steam Turbines.—STEVENS AND HOBART.—The first part of an article on the effect of admission pressure on the economy of steam turbines. The article is fully illustrated by diagrams and contains extended tables.—Lond. *Eng'ing*, March 2.

Crane Motors.—HILL.—The conclusion of his paper the first part of which was recently abstracted in the Digest. The author deals with the effect of the load factor, and discusses the design of controllers for crane motors.—Lond. *Elec.*, February 23.

Traction.

Self Induction in Steel Rails.—WILSON.—The author has experimented with two bull-headed rails of iron having a specific resistance of 21.5×10^{-6} ohms per cubic centimeter at about 9°

C. The object of his tests was to discover how the ohmic resistance of the rails is varied when alternate-currents of different magnitudes traverse them at different frequencies; how much the potential difference (impedance volts) between the ends of a given length of rail is increased over the direct-current value under the action of alternating currents of different magnitudes and frequencies, when the return circuit consists of a copper conductor suspended parallel with the rails at different distances from them; how, when two rails are used in parallel, the potential difference between their ends varies for a given height of the suspended conductor as the distance between the rails is varied; and finally to find the self-induction of circuits consisting of a rail or rails and a parallel overhead conductor. The results are given in tables and diagrams. The author first found that for a given frequency the ratio of the ohmic resistance to alternating and direct-currents is greater the higher the current. The next experiments were made with one rail and the return overhead conductor, and then with two rails in parallel using the same overhead conductor as a return. The height of the conductor over the rail was changed. The results for the frequency of 100 are given in Fig. 3. The circuit formed of one

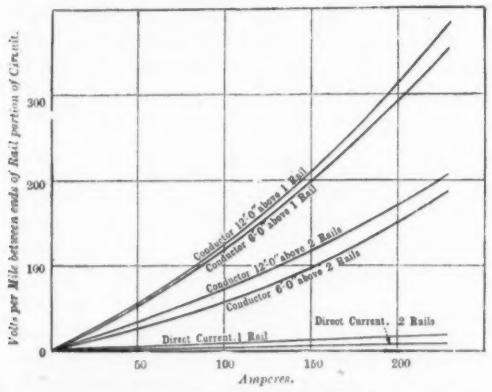


FIG. 3.—CURVES SHOWING RESULTS OF TESTS.

rail and the conductor had a self-induction of 29×10^{-5} henries at frequency 50 when 150 amperes traversed the rail, and 36×10^{-5} henries at frequency 23 with the same current value. Comparing these with the self-induction obtained when the overhead conductor was 12 ft. above the rail at corresponding frequencies and current, we see that the 12-ft. air space only about doubles the self-induction of the circuit. And yet there is evidence to show that the frequencies dealt with are enormous as compared with the frequencies which would be required to produce an approximately uniform distribution of current over the section of the rail. That is to say, at the frequencies dealt with the outer layers of the rail are carrying most of the current. The greater penetration at the lower frequencies is shown by the increased self-induction.—Lond. *Elec.*, February 23.

Three-Phase Traction in Simplon Tunnel.—The Simplon tunnel is to be opened early this summer. At the end of last year Brown-Boveri & Co. offered to install electric traction and to finish the equipment before the opening of the tunnel. This offer was made in order to enable a comparison between steam and electric traction on a line suitable to show the special advantages of electric traction. Mainly on account of the difficulties of ventilation this offer was accepted by the Swiss State Railways. In view of the short time available it was impossible to devise a new system, but since Brown-Boveri & Co. are building for the Italian Valtellina Railroad two three-phase locomotives each of from 900 to 1,000 hp, and since it appeared possible to use these locomotives for the Simplon tunnel, the three-phase system was selected. Its choice was therefore due mainly to incidental causes. At each of the two terminals of the tunnel, which is 20 km. (12 miles) long, there exist water power stations, each of which furnished up to the present time the power for the many motors used in the construction of the tunnel. The plants will now be used for traction purposes, three-phase currents being generated at 3,300 volts and 15 periods. For the present, only the tunnel proper is to be operated electrically; the current will, therefore, be supplied immediately without transformation to the trolley wires, the rails being used for the return current. When a train arrives at one terminal the steam locomotive is replaced by an electric locomotive which is again taken off when the train has passed the tunnel. The locomotives have three driving axles besides two running axles. The motors are built for two speeds, namely 34 and 68 km. (20 and 41 miles) per hour, the speed being changed by changing the whole connections. The draw-bar pull of the locomotive is six tons at the lower speed, and 3.5 tons at the higher speed. All switches are operated by compressed air; there are two electrically-driven air-pumps operating independently of each other.—*Elek. Zeit.*, February 22.

Single-Phase Railway in Switzerland.—The Oerlikon Company will equip the Valle-Maggia Railroad from Locarno to Bignasco. The road has a length of 27½ km. (about 17 miles). The steepest grade is about 3.3 per cent. The gauge will be one meter, and the trains will weigh up to 55 tons. Single-phase current will be used at 5,000 volts. The motor cars have four axles with four 40-hp single-phase motors; trailers will also be used for passengers and freight. An available water power will be used, and the power house, which will not be very far from the center of the road, will contain two 350-kw generating sets. This railroad will be the second one in Switzerland to use single-phase current. The first one is an experimental road from Seebach to Wettingen, which was also equipped by the Oerlikon Company, and operates at 15,000 volts. The results of this first road have been so satisfactory that the railway department of the Swiss government permitted at once the use of 5,000 volts on the trolley wire. This is the highest voltage used so far in Switzerland, with the only exception of the experimental road mentioned above.—*Elek. Zeit.*, February 22.

British Traction System.—The first part of an illustrated description of the Greenwich power house of the London County Council Tramways. Its total capacity will be 34,000 kw., but this has been divided into two parts, of which the first only is being proceeded with at present. This part contains four machines of 3,500 kw capacity each, so that the total is 14,000 kw. The second part will have four machines of 5,000 kw each. Three-phase currents are generated at 6,600 volts and 25 periods (the center of generators being earthed), and are transmitted to motor-generator sub-stations, where they are converted to direct current at 550 volts.—Lond. *Elec.*, February 23.

Installations, Systems and Appliances.

Operating Switches from a Distance Without Auxiliary Wires.—Multhauf.—In order to disconnect distant transformers for the purpose of avoiding no-load losses, or in order to change the connections of double-tariff meters a simple and cheap method is valuable for central stations. For cheapness it is important that no auxiliary wires should be used. The author

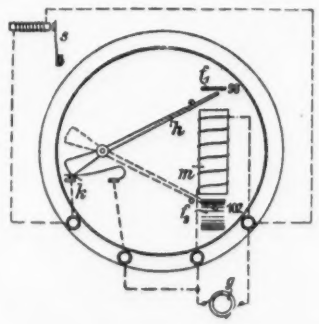


FIG. 4.—DIAGRAM OF SWITCH CONNECTIONS.

accomplishes this result by sending currents of special frequencies over the supply network to relays which operate the switches and which are tuned to certain frequencies. If the system is to be used in direct-current stations, a small machine is to be installed in the power plant for generating alternating-current or pulsating direct-current of variable frequency, this current being then superposed on the direct-current of the power plant. The

most important device of the system is the receiving relay. Its principle may be seen from Fig. 4. It consists essentially of steel tongues tuned to certain frequencies. If currents of the proper frequencies are transmitted over the supply wire, the tongue tuned to this frequency begins to vibrate and produces the desired connection either by a mechanical push or by closing a special auxiliary circuit. *m* is an alternating-current magnet which is able to set into resonance vibrations at least two steel tongues showing in cross-section in Fig. 4 at f_1 and f_2. The normal frequency in the power plant may be 100 periods per second and the largest change in this number above or below the normal value may be 1.5 per cent in ordinary service. In this case one tongue is tuned to 98 (the upper one in the illustration) and the second to 102 alternations. If the number of alternations is intentionally raised in the station to 102 or if a special current of this frequency is sent over the wire, the tongue, f_2, begins to vibrate rapidly and closes a contact, *k*, for instance, by means of the lever, *h*, which is movable between two positions of equilibrium. The vibrating tongue pushes the free end of the lever out of one position of equilibrium (shown by dotted lines in the illustration) so that the lever is thrown over to the other position of equilibrium (shown in drawn-out lines). In this new position the lever closes a circuit which may be used in a well-known manner, for instance, to produce attraction of the armature of the switch, *s*. This situation will remain unchanged until intentionally a current of 98 alternations per second is sent over the wire. Then the tongue, f_1, will be set in rapid vibrations and will throw the lever back into the position shown in dotted lines so that the contact, *k*, is now broken. Several modifications are described, together with the application of the author in central stations.—*Elek. Zeit.*, February 8.

Charging Batteries in Groups.—EDLER.—The first part of an article on charging batteries in groups. Since the charging voltage of a storage battery is much higher than the discharge voltage, a battery can be charged at the supply voltage; i. e., without the use of boosters, etc., only when it is divided into groups which are connected in series during discharge, but are connected differently during charge. For a long time it was usual to divide the batteries into two groups which were connected in parallel during charging with the aid of proper series resistances, while the two groups were connected in series for discharge, the resistances being then disconnected. More recently methods have been devised by which the battery is divided into three groups whereby the loss in the charging resistances may be considerably reduced. The author gives the formulas for the different arrangements possible.—*Elek. und Polyt. Rundschau*, February 1.

Wires, Wiring and Conduits.

Paper Versus Rubber for Cable Insulation.—TAMLYN.—A comparison of paper and rubber used for insulating cables for three-phase distribution to sub-stations in cities, using, say, a frequency of 25 cycles and potentials of from 6,000 to 12,000. Neither kind of insulation is perfect; in a given case the success or failure of a cable depends upon the care used in the design and manufacture and upon the service conditions. Since paper cables are cheaper in first cost than rubber, and will last as long as the sheath remains intact, they are undoubtedly better in places where there are no grounded direct-current trolley systems, or where the electrolysis caused by such systems can be eliminated. It still remains to be shown that the life of rubber cables, installed where ordinary city conditions obtain, is independent of the life of the sheath. This is especially true in view of the well-known action of even dry air on rubber. Vulcanized rubber, while it will last longer than pure rubber, is by no means free from deterioration. Paper will stand a temperature of 90° C. for a time without any bad effect, although the regular working temperature should not be allowed to rise as high as this. Rubber cannot stand more than 65° or 70° C. for even a short time without softening. The specific inductive capacity of paper is less than half that of rubber. This is an important item, because the loss due to the capacity of the line is directly proportional to the specific inductive capacity of the insulation between the conductors. The following results of a test of the New York Edison Company are quoted:

DIELECTRIC LOSSES IN TRIPLEX CABLES OPERATING AT 6,400 VOLTS, 25 CYCLES.

	Paper cable.	Rubber cable.
Length, feet	10,935	24,756
Copper, cir. mils	250,000	250,000
Insulation	10/32-in.	10/32-in.
Temperature (about)	80° F.	80° F.
Charging current in amperes, working conditions.	0.47	2.16
Total watts lost	312.6	4266.
Watts lost per ft	0.02859	0.1723

These figures show a decided advantage in favor of the paper-insulated cable.—*Eng'ing News*, March 15.

Electric Wiring of Small Buildings.—ROBSON.—An abstract of a paper read before the New Castle section of the British Inst. Elec. Eng., on the electric wiring of small buildings during course of erection. The aim should be to compete with gas in cheapness, and to do this some cheap method must be adopted, such as the American split insulator system, though that requires that the wires to switches be carried in insulating tubes. The author commends the bituminized tubing and in reply to the objection that it is liable to be pierced by nails, says that the same thing applies to light steel tubing. His special abhorrence is close-joint tubing. —Lond. *Elec. Times*, February 15.

Determination of Feeder Drop.—WALLACE.—With reference to a former article in ELECTRICAL WORLD the author gives an analysis of the economics of feeder transmission and a formula for calculating it, together with a curve-chart for estimating feeder drop. —*St. R'y Jour.*, March 3.

Electrophysics and Magnetism.

Hysteresis Loss.—SUMPNER.—A communication pointing out that Steinmetz's hysteresis law is purely empirical and is not exact over the whole range of induction. Steinmetz's law contains the 1.6th power of *B*. As noticed in the Digest, Wild recently found that for very low values of *B* the exponent should be 2.7 instead of 1.6. The writer points out that there is nothing surprising in that. He has investigated the behavior of electromagnets for instrument purposes and has proved that the phase difference between the magnetizing current and the magnetism is dependent upon the ratio of *E* to B^2, where *E* is the energy loss in hysteresis for a cycle of maximum flux density, *B*. Now, if in the equation $E = B^x$, the exponent, *x*, is less than 2, the ratio of *E* to B^2 must decrease as *B* increases. This is true for values of *B* over 1,000. The curve connecting the value of E/B^2 with *B* has a maximum value for some value of *B* generally lying between 600 and 1,000, and as *B* is diminished below these values the value of E/B^2 falls very rapidly, showing that if $E = B^x$ the value of *x* must be greater than 2 for these low values.—Lond. *Elec.*, February 23.

Non-Metallic Condenser.—RUDGE.—An account of an investigation in which the author found that an ordinary vacuum tube or incandescent lamp may be made into a condenser by coating it with tinfoil on the outside only, the exhausted air acting as the inner coating. And, further, the outside coating may be replaced by a second vacuum surrounding the first, thus obtaining a condenser without any metallic coatings. Such a condenser is shown in Fig. 5. Exhaustion need not be carried beyond 1 cm. of mercury. Charging may precede exhaustion without greatly altering it, and the air may be renewed between charge and discharge without greatly reducing the effect.—Lond *Elec.*, February 23; from *Proc. Cambridge Phil. Soc.*, January 31.

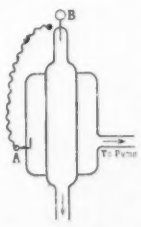


FIG. 5.—NON-METALLIC CONDENSER.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—WITT.—A lecture on the practical results obtained with the Birkeland-Eyde process used in Norway for the fixation of atmospheric nitrogen. The principal trouble was to work up into acid of merchantible strength the very weak acids and highly diluted acid vapors issuing from the apparatus. It is stated that water power may be obtained at the place where the process is in use in Norway at a price of not more than $3 per hp-year. This makes it possible to produce the nitric acid so cheap as to compete with Chili saltpeter. Cal-

cium nitrate is the product sold. The immediate future for the synthetical product appears to lie in those branches of applied chemistry and agriculture where absence of chlorine and sodium compounds is desirable in the nitrogen compounds produced.—Lond. *Elec. Rev.*, March 2.

Accumulators.—Schoop and Liagre.—The first part of an illustrated article on containers for alkaline and lead accumulators. In the present installment the authors discuss the construction of hard rubber containers. Data are given as to the impurities which may be permitted in hard rubber for such purposes. The method for making a hard rubber container is described together with a test of determining the soundness of the walls by means of an induction coil.—*Electrochem. and Met. Ind.*, March.

Zinc.—Meyer.—A review of the zinc industry in the year 1905. After a sketch of the commercial situation, the author discusses the ores now available, and new developments in roasting and smelting. The same issue contains a very full description of the new Hazard zinc works of the New Jersey Zinc Company, both of the spelter and of the zinc oxide plants.—*Electrochem. and Met. Ind.*, March.

Hypochlorite.—Digby.—An illustrated account of two tests of electrolytic hypochlorite plants in England.—*Electrochem. and Met. Ind.*, March.

Electrochemical Progress.—Spiers.—The first part of a review of electrochemical and electrometallurgical progress in 1905.—Lond. *Elec. Rev.*, February 16.

Units, Measurements and Instruments.

Three-Phase Leakage Indicator.—An illustrated description of a leakage indicator devised by Ferranti for use on three-phase circuits when the middle point is not earthed. Fig. 6 shows the

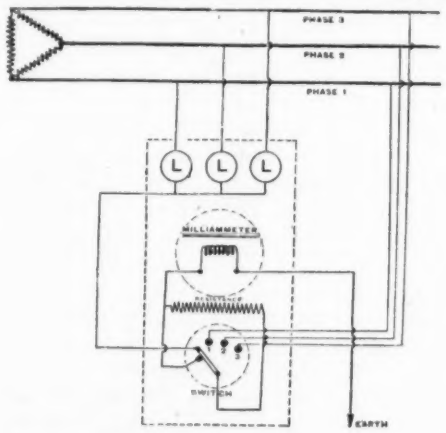


FIG. 6.—LEAKAGE INDICATOR CONNECTIONS.

connections. The apparatus consists of a milliamperemeter of the long-scale type working on the induction principle, a four-way switch provided with an automatic spring back arrangement to keep it normally on the first contact, and three incandescent lamps all mounted on one board. The lamps are connected in star fashion to the three phases, and the neutral point thus formed is connected to the first contact of the switch. When the switch is on the first position the milliamperemeter will indicate the current passing to earth from the neutral point. In the other positions of the switch one of the three phases is put to earth through the milliamperemeter and a resistance. If, when the switch is on position 1, the instrument reads a full scale deflection; it shows a dead earth on either phase 2 or 3. If the same result is obtained on position 2 it proves that the earth is on phase 3. If, instead of a full deflection, the instrument reads D milliamperes, the insulation resistance, R, of phase 3 can be calculated from the formula $\frac{V}{R'+R} = \frac{D}{1{,}000}$, where V is the voltage between phases, and R' is the resistance of the instrument. It is intended that on each day readings should be taken with the switch in all four positions. If there be no leakage, the milliamperemeter will not read at all and the lamps will glow with equal dullness. A bad earth will put out the lamp on the earthed phase and cause the other two to light up more brightly, at the same time causing a large deflection on the milliamperemeter.—Lond. *Elec.*, March 2.

Electric Waves.—Fleming.—The conclusion of the reprint of his Cantor lectures on the measurement of high-frequency currents and electric waves. The lecture given in the present installment deals with stationary electric waves on wires.—Lond. *Elec.*, February 23.

Phasemeters.—Sumpner.—An article, illustrated by diagrams, discussing the constructon and operaton of phasemeters and their calibration.—Lond. *Elec.*, February 23.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Pierce.—This fourth paper on experiments on resonance in wireless telegraph circuits. The first discusses the direct-coupled type of sending circuit and gives resonance curves with this type of sender and various forms of receiver. He finally discusses the image theory of the action of the ground of a grounded circuit. According to this theory the action in the grounded circuit with the receiving instrument near the ground is the same as it would be if instead of being grounded it should be symmetrically duplicated below the surface of the earth. The author describes experiments which show a good agreement between the observations and the predictions from the image theory of the action of the ground. They also show that it is a simple matter to balance the aerial at the receiving station with an artificial ground that will increase the reception of energy (current square) by twenty per cent or twenty-five per cent over a good actual ground.—*Phys. Rev.*, March.

Miscellaneous.

Equipment of British Manufacturing Plant.—The first part of a well-illustrated description of the works of Veritys, Ltd., at Aston, manufacturing motors and fans, switches and controllers, arc lamps and fittings.—Lond. *Elec. Rev.*, March 2.

Liege.—Corsepius.—Some supplementary notes on various electrical exhibits at last year's International Exhibition in Liege.—*Elek. Zeit.*, February 8.

BOOK REVIEW.

Les Enroulements Modernes. By A. Meynier and H. Nobiron. Paris: Ch. Beranger. 53 pages, 41 illustrations.

The authors have set themselves the task of investigating and expressing a general theory of direct-current armature winding capable of embracing all the many varieties of windings which have been used or which are used to-day. This pamphlet is, therefore, a useful little text-book on the arithmetic of armature windings, a very practical, and at the same time a very complete, subject. Many of the theorems have already appeared in books devoted to armature winding; but the collection of the material in this form has distinct merit. The pamphlet will be of interest and use to students of direct-current machinery and to dynamo designers.

Single-Phase Equipment for Central Illinois.

The Central Illinois Construction Company has adopted single-phase, alternating-current trolley supply, catenary construction for the additional 80 miles of track being constructed, and its use is anticipated on later extensions. The portion of track to be so equipped consists of two 40-mile lines, one connecting Bloomington and Peoria, the other lying between Springfield and Lincoln. The present equipment of the Central Illinois Construction Company is direct current, consisting of heavy suburban type cars equipped with four General Electric 75-hp motors, and their local demand for power is considerable when accelerating or when operating on grade. The cars contemplated for the new extensions are still heavier and it is evident that the question of secondary distribution is one of great importance when such large equipments are used over a system so extensive. There is now high-tension distribution from the Riverton station at 13,200 volts, but this line is being changed to 33,000 volts, and the latter station will be

supplemented by a second power house located in Peoria with a common 33,000-volt transmission line connecting the two stations.

The equipment includes ten 75-hp compensated motor car equipments, together with necessary sub-stations, overhead line material, generating station equipment, etc. Each car equipment consists of four 75-hp motors with Sprague-General Electric system of multiple unit control adapted for use on alternating-current circuits. These are so arranged that they will permit tap control when running on alternating current, and series-parallel resistance control when running on direct current. In addition to the motors and control apparatus, complete alternating-current-direct-current General Electric air compressors and straight air brake equipments will be installed, as well as arc headlights adapted for use on 25-cycle alternating current. The trolley will be of the pantagraph type with rolling contact, raised and lowered by compressed air.

The equipment just outlined will take care of the passenger service, but for hauling freight the operating company will employ a single-phase locomotive equipped for service on the same roads as the regular motor cars. This locomotive will be of the eight-wheel type, equipped with four General Electric 125-hp compensated alternating-current motors. The total weight of the locomotive complete will be 50 tons with a draw-bar pull of 20,000 lb. It will haul its train at a speed of 20 miles per hour with the current supply at 3,300 volts and 25 cycles. In common with the motor cars for passenger service the locomotive will be equipped with the Sprague-General Electric multiple unit control for operation on both direct and alternating currents. It will also be supplied with complete air brake equipment of the General Electric type, comprising an alternating-current-direct-current motor-driven air compressor with the straight air brake apparatus.

To furnish additional power for this new rolling stock, the present generating station at Riverton will be supplemented by a 2,000-kw Curtis steam turbine furnishing current at 25 cycles, and the new power house at Peoria will be equipped with two 2,000-kw Curtis turbines. The generator and high-tension distribution system will be three-phase and will feed the present rotary converter sub-stations, and also the 80-mile section of track operating with alternating current.

Dayton Fans.

The Dayton Fan & Motor Company, Dayton, Ohio, has revived the Dayton ceiling fan as originally placed on the market in 1892, but with an ornamental basket armature carrier instead of a plain one. The manufacturers state that many thousands of these motors have been in use constantly without repairs for from ten to twelve years. The fan is supplied with or without a switch for three speeds, and either two or four blades are furnished. The speed is 215 r.p.m. and the shipping weight of the motor is 50 lb. The motors are wound for 110, 170, 220, 250 and 500 volts.

Tuerk Alternating-Current Ceiling Fans.

The Hunter Fan & Motor Company, Fulton, N. Y., has added to its line of alternating-current ceiling fans two new types, both employing induction motors. The motors are designed for 40, 50 and 60 cycles and for voltages from 50 to 250 volts. With one type, when two blades are used, these are of 56-in. sweep, and 52-in. sweep with four blades. The speed is 225 r.p.m. All bearings run in oil. The second fan type is more moderate in price than that described above. It is equipped with either two or four blades of 60-in. sweep, the width of the blades being 8 in. The current consumption is 110 watts at full speed of 175 r.p.m. and 80 watts at a second speed of 150 r.p.m. The motor is equipped with a pull switch, the first pull starting the motor, the second pull on the chain securing the second speed. An indicator tells at a glance the speed and also when the current is off. The case is well ventilated and all bearings run in oil.

The Wireless Lamp Cluster.

The accompanying illustrations show some of the applications of the Benjamin wireless cluster, made by the Benjamin Electric Company, Chicago. The clusters are now made for from two lights to seven, in all of which the same principle is employed. A brass punching screwed on a porcelain base is connected with one terminal of the line and serves as the center contact for all of the lamps in a cluster. Lamp sockets are soldered into a hemispherical cap fitting over the base, this cap forming the other terminal of the line. There is approximately one-fourth of an inch of space between the cap and the center contact, thus removing all possibility of short-circuits. An outer hemispherical covering, which is highly polished and lacquered, is held in place

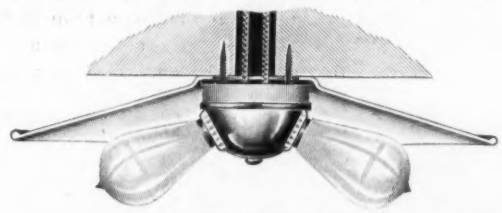


FIG. 1.—TWO-LIGHT CLUSTER.

by the lamp socket porcelain rings, and is lined with a heavy fibre insulation. On that style of cluster not provided with a socket in the center this insulation is secured in place by an insulating bushing inserted through the cap. The bushing is provided with a knockout center which, when removed, permits a cord to be run through for the attachment of a pendant switch, an extension light or a fan.

The wireless cluster is particularly adapted for street car lighting, not only adding to the interior appearance of the car, but obviating trouble from short-circuits frequently encountered with the ordinary type of wired cluster, through the constant vibration of the car loosening a screw. The two-light cluster, shown in Fig. 1, is that most frequently used in electric cars. Three, four and five clusters are also made especially for this use. A reflector may be placed above the lamps close up against the ceiling, and a special porcelain enameled reflector for this purpose removes the chief objection to the use of reflectors on cars, as it is of steel and is not easily broken.

"The "arc burst," which for some uses is replacing arc lamps, is a development of the wireless cluster. Immediately below a broad porcelain shade are arranged incandescent lamps, the center one being usually of 50 cp and sometimes provided with a separate

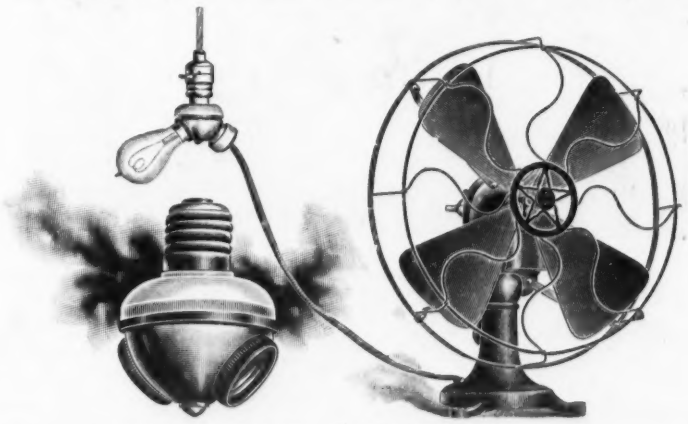


FIG. 2.—FAN MOTOR EXTENSION CONNECTION.

reflector. By adding the "turn-down" feature, an advantage through reduction in electric light bills may be obtained over the arc lamp. This attachment permits the bottom lamp to be lighted independently of the others. In residence lighting a very small lamp may be employed in the center and then this alone may be kept burning at night. In store lighting also the attachment is used to considerable advantage. "Arc bursts" and in fact all the Benjamin wireless clusters, are made with long or short stems for rigid attachment to ceilings. In such cases a copper-plated

steel flange is screwed to the top of the porcelain base of the cluster proper, and into the threaded center of this the stem is inserted.

For large halls, churches and other places, where a desired effect can be produced only by the installation of an unusually large cluster of incandescent lamps, a wired cluster is made to hold as high as 20 lamps, and larger sizes are made on special order. This cluster contains a minimum amount of wire, and consists essentially of a metal shell with porcelain receptacles of special design fastened into properly spaced openings. As the body of the receptacles is in the interior of the shell and not visible, the cluster when filled with lamps has a very attractive appearance. The wires inside connecting the receptacles are approximately one inch from the shell or other metallic part of the cluster and there is consequently no danger of short-circuits.

The wireless idea has been well applied to a twin socket with a plug attachment, shown in Fig. 2. By removing a lamp and inserting the plug, two lamps may be employed or a lamp and

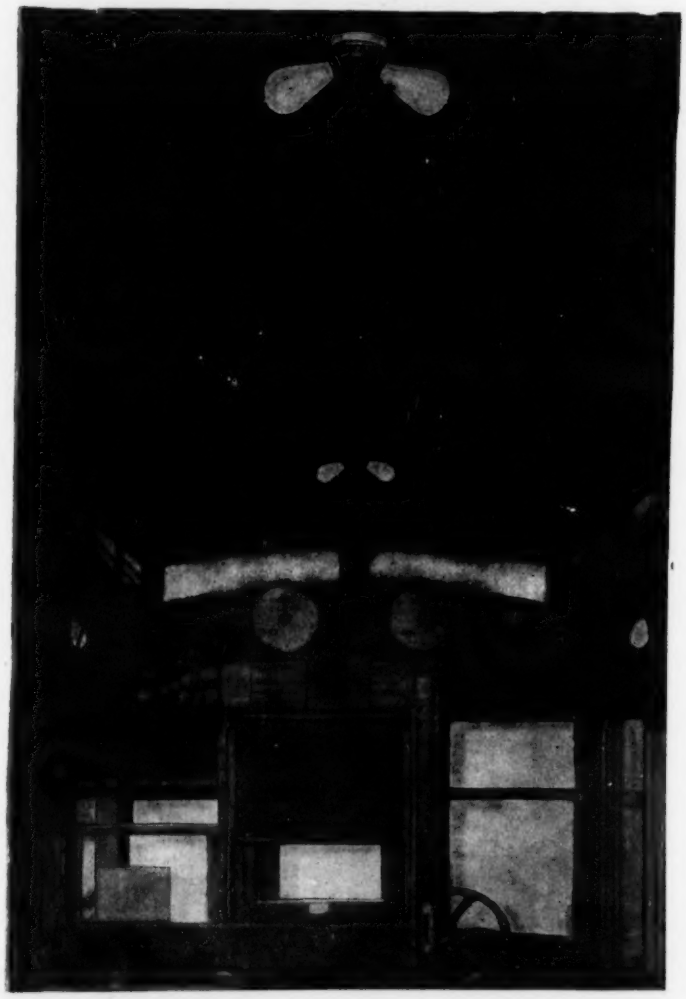


FIG. 3.—VIEW OF "CAN'T-BREAK" GUARD.

a fan or other electrical device may be attached as desired. A receptacle plug by which one light pendant may be converted into a cluster is made up to four-light capacity. The two-light receptacle plug is often employed to connect a fan in circuit as shown in one of the illustrations. For use in factories and shops the "can't-break" guard, shown in Fig. 3, has been developed. The guard is in two halves pressed from sheet steel. A spring in each half bears on the lamp at four points, thus not only keeping it centered, but removing a portion of the strain from the socket. As this guard follows the shape of the globe closely, it is especially adapted for use in shops and factories where it is sometimes necessary to put the lamp up close to the work or into a small aperture.

The development of the wireless cluster necessitated the design of special shades, shade holders and lighting fixtures of various kinds. The attractive appearance of the wireless cluster when studded with several lamps with lighted globes has led to the development of a device called the candelabra plug, intended to be inserted in a socket instead of a single lamp when rooms are to be decorated temporarily. In it can be put seven candelabra lamps, which may have bulbs of two or more colors.

Emerson Fans.

The Emerson Electric Manufacturing Company, of St. Louis, embodies in its fans for the coming season a number of improvements. The line consists of desk and ceiling fans for alternat-

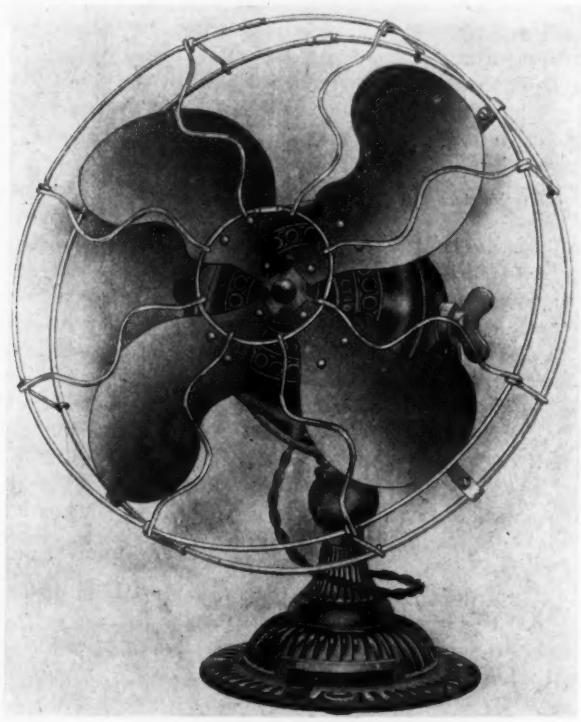


FIG. 1.—EMERSON DESK FAN.

ing current and desk fans for direct current, which are marketed under the trade names "Emerson" and "Trojan." Each of the 1906 type of desk fan is equipped with a new convertible bracket base, by means of which any desk fan may be changed into a sub-

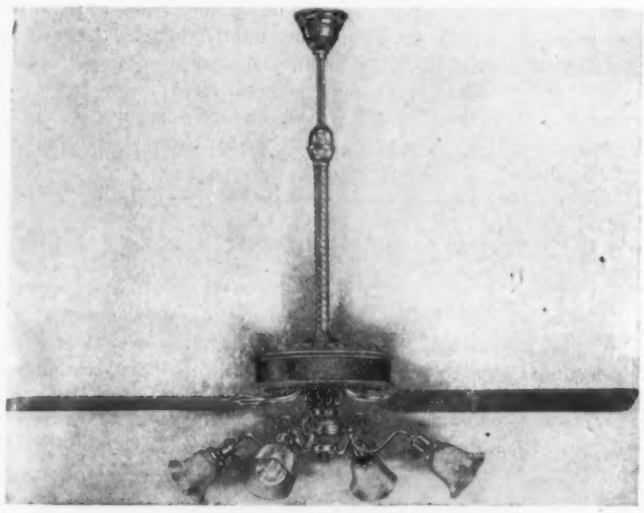


FIG. 2.—EMERSON CEILING FAN.

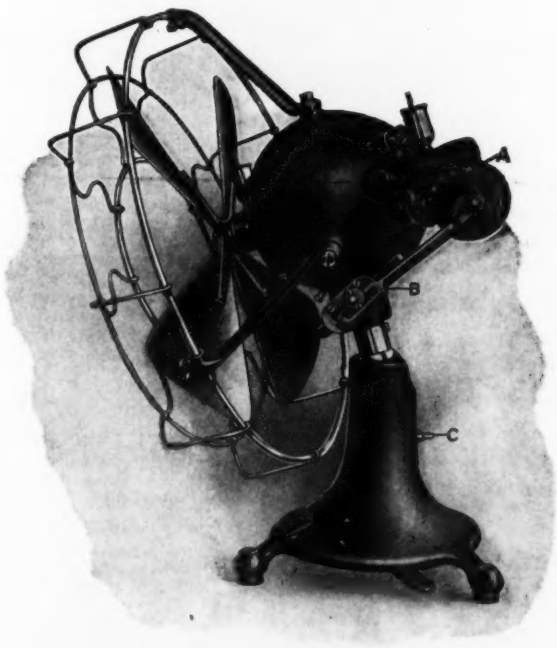
stantial bracket fan in a few seconds without extra parts. The new bracket adjustment is positive and secure, not dependent on thumb screws. As the faces have swivel and trunnion arrangements it is expected that a large number of these new types will be installed as bracket fans.

The desk fans for 60 cycles have two speeds and start promptly on either speed, being equipped with special automatic starting device and the power motor form of field winding introduced by the Emerson Company several years ago. In addition to 12 and 16-in. standard medium speed fans for store and office, a special slow-speed, quiet residence type is made. Each of these fans is equipped with six blades.

The 1906 Emerson ceiling fans for 60 cycles are equipped with a three-speed indicating snap switch and have much more satisfactory speed regulation than it has been possible to secure heretofore. New style decorative electrolier arms with wide spread can be used on these new fans, which are furnished with the familiar Emerson adjustable hanger. Trojan 1906 types of ceiling fans have two speeds. Two and four-blade styles, as well as column fans, are made in both "Emerson" and "Trojan" lines and all types are direct-connected to motors with automatically-oiled ball bearings. All alternating fans are of the induction type without brushes or commutator.

Eck Oscillating Fan.

The accompanying illustration shows the "Hurricane" oscillating fan made by the Eck Dynamo & Motor Works, Belleville, N. J. As will be seen, the oscillating motion does not depend upon air action, but is controlled by a positive direct drive, which admits of ready changes and adjustment without the use of a screwdriver or wrench, when it is desired to regulate the arc or speed of oscillation. The trunnion or ball-and-socket joint between the motor stem and the base permits a quick adjustment to regulate the general direction of the breeze. By means of this joint the desk pattern shown in the illustration may be changed at once into a wall or bracket fan. To overcome the objectionable humming noise of motors, some makers use fans of a very small pitch, thereby greatly reducing the efficiency. In the Eck fan the blades are of full pitch and yet in running at high speed give rise to a minimum of noise. The fan is supplied with an automatic grease cup, which gives just enough lubrication to insure easy and cool running, and one filling is enough for an entire season. The brush holder is so designed that new carbons, if necessary, can be fitted without disconnecting any wires. When the carbon wears too short, the fan stops and the holder can never come into contact with the commutator.



ECK OSCILLATING FAN.

Western Electric Universal Fan Motor.

Among the 1906 types of fans made by the Western Electric Company is a new design of alternating-current fan shown in the accompanying illustration. This fan is manufactured in one type and one size only, but the design is such that it can be easily converted into a desk or bracket type without the use of an adapter, a loose part which may easily be lost. A thorough consideration of the construction of blades led to the adoption of the 15-in. fan and of a pitch which insures a maximum efficiency.

FIG. 1.—WESTERN ELECTRIC UNIVERSAL FAN.

FIG. 2.—WESTERN ELECTRIC UNIVERSAL FAN.

The motor is spherical and entirely enclosed, thus insuring against trouble from the collection of dirt and dust. The armature is of the slotted type and has a commutator designed to withstand long and continuous service. The field coils are elliptical in shape, machine-wound and especially insulated for the severe service of a fan. The brush holders, which are of the cartridge type, are designed to avoid the possibility of excessive brush pressure on the commutator and are fitted with carbon brushes. The brushes may be adjusted, inspected or renewed without removing the bearing and bracket. By means of a switch in the base there is a choice of speeds of 1,480, 1,100 and 750 r.p.m., re-

spectively. The speed rheostat consists of an iron spool, heavily coated with porcelain, and a winding of German silver wire imbedded in and completely protected by a coating of white enamel. As will be seen from the illustration, the motor is mounted on trunnions, which admit of 30° depression and 15° elevation, and the base construction allows the fan to be rotated horizontally through 120°. The oiling is by means of a felt wick fed from an oil cup attached to the bearing bracket.

Westinghouse 1906 Electric Fans.

For the season of 1906 the Westinghouse Electric & Manufacturing Company has placed a largely increased assortment of electric fans on the market, made for both direct and alternating-current service in the forms known as desk type, bracket type, ceiling type, floor column type and counter type. One of the notable features of the desk and bracket types are the blades, which are a departure from the design in ordinary use. They are constructed upon exact mathematical principles, the angles being theoretically correct, with the result that the fan will give an even air pressure across its entire front, as there is an absence of the tendency to project a hollow cone of air which is found in the usual fan. The breeze is sent out in the shape of a solid cylinder of air, there being little tendency to set up eddying currents with their attendant losses. It is stated that the design of these blades has resulted in an extremely high air delivery, while the total watt consumption has been decreased. The motor is mounted upon trunnions, the line of support of which passes through its center of gravity, and is, therefore, balanced at any angle; the fan is secured in any position by two thumb screws, one holding it in any horizontal position and the other in any vertical. The thumb screw which retains the fan at any angle in a horizontal plane is a recent modification, superior to former methods in which friction washers were employed, and holds the fan securely in any position to which adjustment has been made.

By means of a simple adapter the desk and bracket types are interchangeable, making it possible for the user to attach the fan in the most convenient location without disconnecting lead wires, thus giving him all the advantages of two styles of mounting.

The ceiling and floor types, which are all in mottled copper as standard, have three speeds and four blades, which are set at angles calculated to give the highest possible movement of air with the least possible consumption of power. The blades are securely attached to the moving element by screws, which effectually prevent them from turning from their normal position.

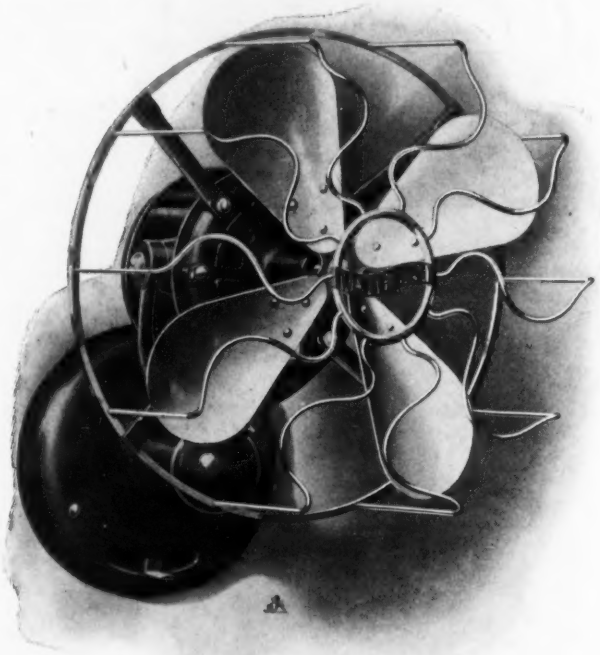


FIG. I.—WESTINGHOUSE DESK OR BRACKET FAN.

FIG. 2.—WESTINGHOUSE CEILING FAN.

Sprague Fans.

The Sprague Electric Company's fans for 1906 maintain the high grade in design and construction which have characterized them in the past, and the high efficiency of the motor, which is of the well-known single-field coil type. These fan motors run quietly without making a distressing noise and are, therefore, suitable for all localities; they consume a small amount of power, and require oiling only once a season; they are constructed on scientific principles and their graceful form blends harmoniously with any style of decoration.

FIG. I.—SPRAGUE CEILING FAN.

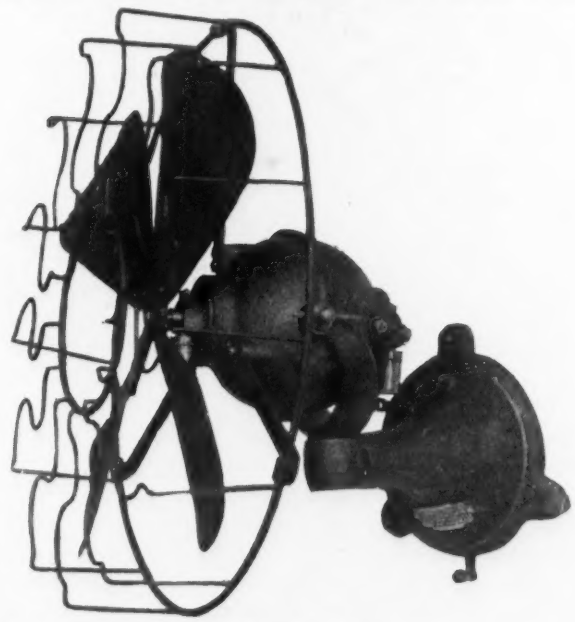


FIG. 2.—SPRAGUE BRACKET FAN.

The Sprague fans include 12 and 16-in. sizes of desk and

bracket types, the desk types being either swivel and trunnion or solid base. In addition a ceiling fan has been designed to meet a popular demand. It is of excellent appearance, and while it is moderate in price is efficient and powerful in service. It has

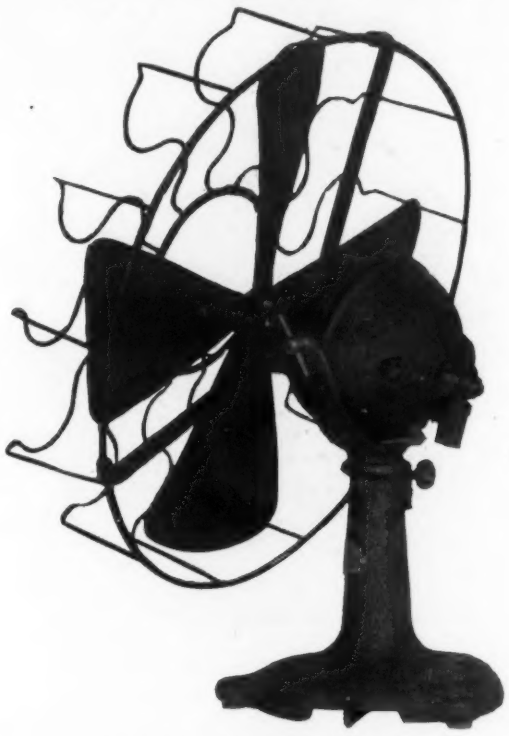


FIG. 3.—SPRAGUE DESK FAN.

four wooden blades of 58-in. sweep, and the motor is furnished in black japan, or an ornamental finish which may be polished brass or oxidized copper.

Pillsbury Alternating-Current Ceiling Fan.

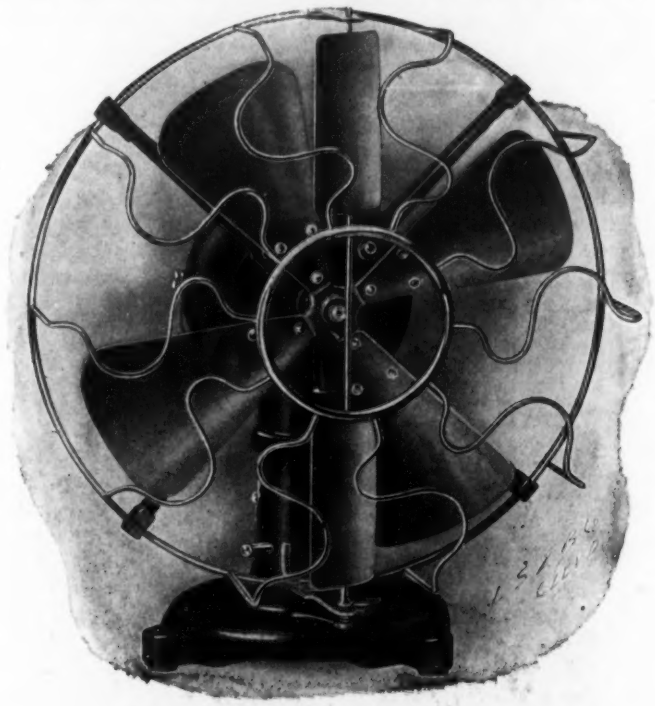
The Century Electric Company, St. Louis, Mo., has introduced a number of improvements in its 1906 type of Pillsbury alternating-current ceiling fan. The manufacturers state that there is no moving wire in the fan and that it can be taken apart for cleaning or inspection without having to disconnect a single wire. Fans for 60-cycle circuits have two speeds, namely, 235 and 180

PILLSBURY ALTERNATING-CURRENT CEILING FAN.

r.p.m. The speed will vary, of course, with the frequency of the circuit, and the fans are made for frequencies between 50 and 67 cycles. While the standard fan is wound for 104 to 110 volts, fans are also made in voltages as low as 100 and as high as 120. The accompanying illustration gives a view of the standard Pillsbury fan.

Peerless Direct-Current Fans.

The 1906 type of direct-current desk fan made by the Peerless Electric Company, Warren, Ohio, is shown in the accompanying illustration. This fan has a swivel and trunnion mounting and

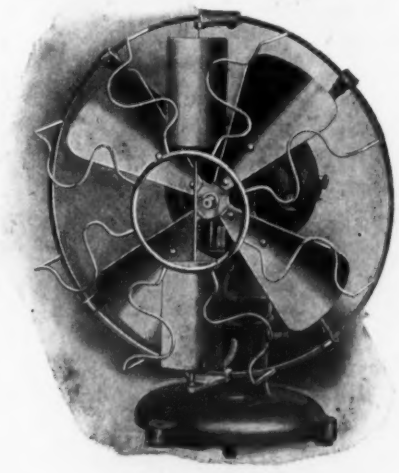


PEERLESS FAN.

three speeds. The fan can be turned in any direction and tilted up or down within an angle of 45° from the horizontal. The 12-in. fan on a 110-volt circuit takes .5 amp., the maximum speed being 1,650 r.p.m. The 16-in. fan on the same circuit takes .8 amp., its highest speed being 1,350 r.p.m. The Peerless oscillating fan has been redesigned for the 1906 season, and in its present form oscillates upon a single ball bearing upon a hardened steel plate.

Star Fans.

The Star Electric Company, Niles, Ohio, enters the fan motor field the present year with a line of direct-current fans. These



STAR FAN.

include a swivel type, a swivel and trunnion type and an oscillating type, which latter is illustrated herewith. The swivel and trunnion fan has provision whereby it may be attached to a wall. The bearings of all the fans are of the self-aligning type, made of phosphor-bronze. They are lubricated by means of wick oil cups of extra large size, which hold sufficient oil to last the entire

season under ordinary conditions; the cups are adapted for the use of heavy cylinder oil, and all fans are provided with a sufficient oil-catching device. Carbon pencil brushes are used, which are controlled by compression springs holding the brushes firmly against the commutator with an even pressure, and the brushes can be used up to almost their entire length. The speed-regulating device is made up of German silver wire wound on a porcelain spool, and enables three speeds to be obtained.

Ventilating Fans.

The accompanying illustrations show two types of ventilating electric fans made by the American Blower Company, Detroit,

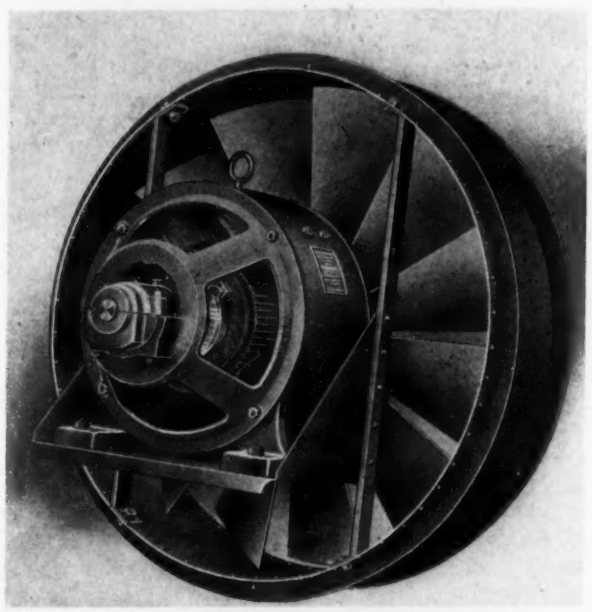


FIG. 1.—AMERICAN BLOWER VENTILATING FAN.

Mich. That shown in Fig. 1 is designed especially for building into a brick wall, the motor being supported on the enclosing case.

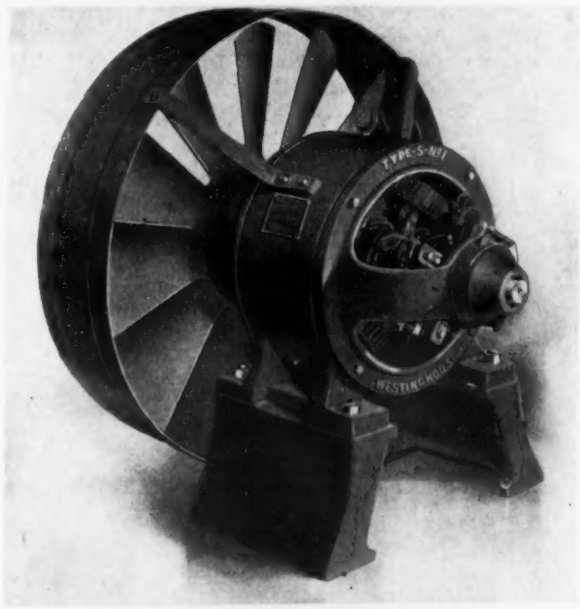
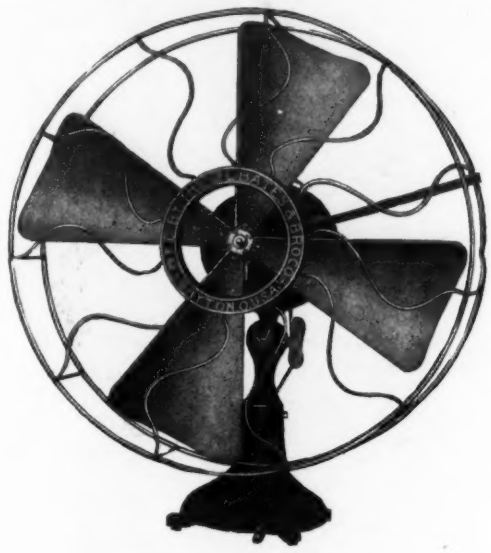


FIG. 2.—AMERICAN BLOWER PEDESTAL FAN.

In Fig. 2, as will be seen, the motor is mounted on pedestals. In each case a fan with 12 broad blades and wide central discs is used.

Bates "Universal" Fan.

The 1906 type of "Universal" fan made by the D. L. Bates & Brother Company, Dayton, Ohio, is shown in the accompanying illustration. By means of a socket joint the fan can be inclined at any angle of the horizontal and it can also be installed as a bracket fan. The blades are of unusual size, being 20 in. in

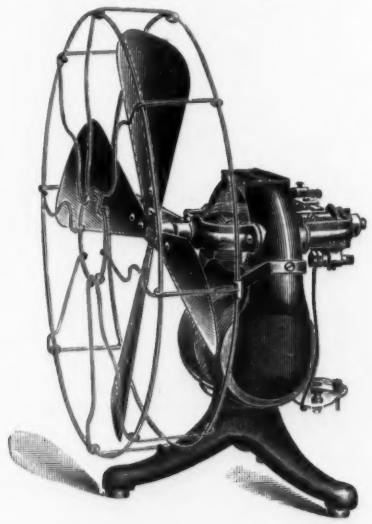


BATES "UNIVERSAL" FAN.

diameter. This fan, as well as the other lines of desk, wall, bracket and ceiling fans manufactured by the same company, are all for direct-current service.

Kenco Battery Fan.

The accompanying illustration shows the Kenco battery fan, made by the Knapp Electrical Novelty Company, of New York. The armature is of the drum type with windings in six slots. The brushes, which are of the radial gauze type, can be removed by a turn of the screw; they have a long spring adjustable tension, thus giving a positive contact. The motor is wound for from 2 to 4 volts and from 8 to 10 volts, in the former case taking 1.5 to 2 amp., and in the latter case 1 to 1.5 amp. The weight



KENCO BATTERY FAN.

of the motor is 7 pounds and its height 7¾ in. Twenty good dry cells, 6 by 2½ in., connected in multiple series, will, it is stated, run the fan three hours per day for at least 200 hours.

Jandus Fans.

The accompanying illustrations show the 1906 types of the Jandus desk fan and "Gyrofan," both of which are made for direct and alternating currents. As will be noticed in the illustration of the latter (Fig. 1), two fans are mounted on either end of a horizontal arm which is mounted to rotate about a

FIG. 1.—JANDUS "GYROFAN."

vertical axis. The two fans can be set to blow horizontally or at any downward angle, and either fan can be set at a different angle from the other. The arm can be set rigid, but otherwise rotates at a speed which can be varied by a simple adjustment; in the former case the two fans can be arranged to direct their current in any desired direction. When forming part of a ceiling electrolier, there is a switch with four contacts, by means of which the fans can be operated alone, the lights alone, or the fans and lights simultaneously. The manufacturers claim that although the "Gyrofan" requires two motors, it consumes 25 per cent less power than the ordinary ceiling fan.

The Jandus desk fan, which is shown in Fig. 2, is made both

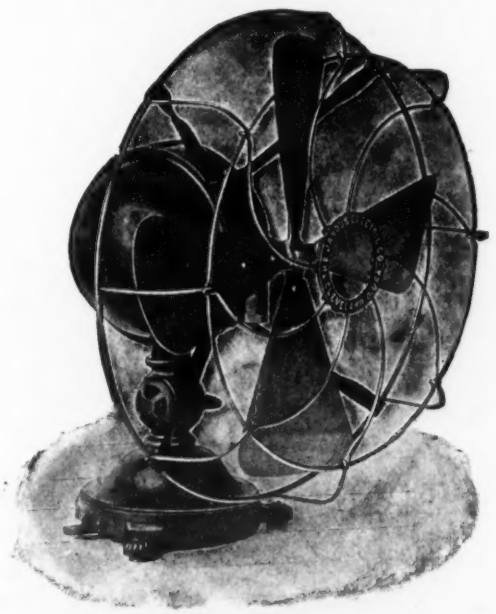


FIG. 2.—JANDUS DESK FAN.

for direct and alternating currents. The armature and field cores are of soft laminated iron and the fields are flexibly supported so as to withstand shocks or jars. The bearings are self-aligning, and while the speed is slow the velocity of air blast is high. The "Gyrofan" is a specialty of the Jandus Company, and has been the subject of several patents covering its novel features; the alternating-current "Gyrofans" are fitted this season for the first time with specially designed induction motors.

Diehl Fans.

For the coming season the Diehl Manufacturing Company offers a line of fans including nine styles of ceiling fans, two styles of column fans and a universal fan. The latter can be changed

FIG. 1.—DIEHL CEILING FAN.

from a bracket to a desk fan or vice versa by simply loosening the screw holding the two halves of the ball on the standard. The position of these pieces is located by a pin on one part engaging a hole in the other. By loosening the screw sufficiently to disengage the pin from the hole the two halves may be rotated on themselves for a quarter turn. When the proper point is reached the pin engages another hole and the change is complete, when the screw is tightened.

The Diehl fan regulators, which give a variation of three speeds, can be installed on all 110 and 220-volt ceiling fans.

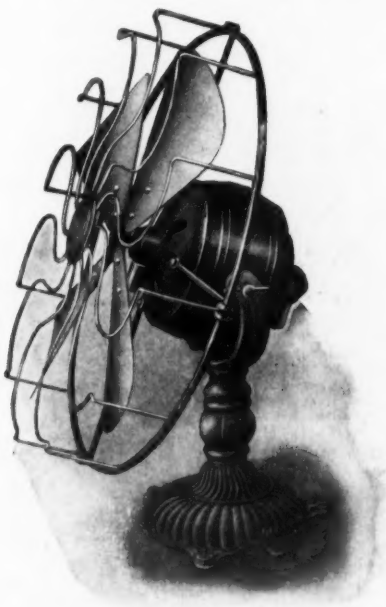


FIG. 2.—DIEHL "UNIVERSAL" FAN.

These regulators are made of mica plate wound with high-grade resistance wire of ample capacity to carry the maximum possible current without undue heating. The plates carrying the wire are separate units and are combined in proper numbers to give the required resistance for the style of fan and voltage.

Robbins & Myers' 1906 Fans.

We illustrate herewith several of the 1906 models of fans made by the Robbins & Myers Company, Springfield, Ohio. Fig. 1 shows a 12-in. desk fan with swivel and trunnion mounting. This

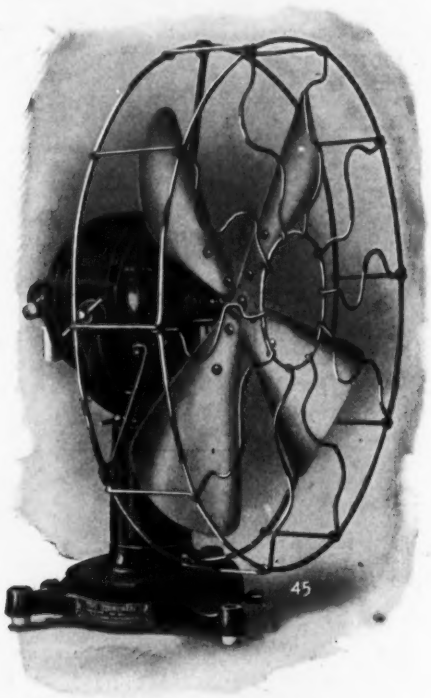


FIG. 1.—ROBBINS & MYERS DESK FAN.

model was first brought out in 1904, but has been improved for the present season. A somewhat similar fan is made in the oscillating type, the propellor swinging slowly from side to side while

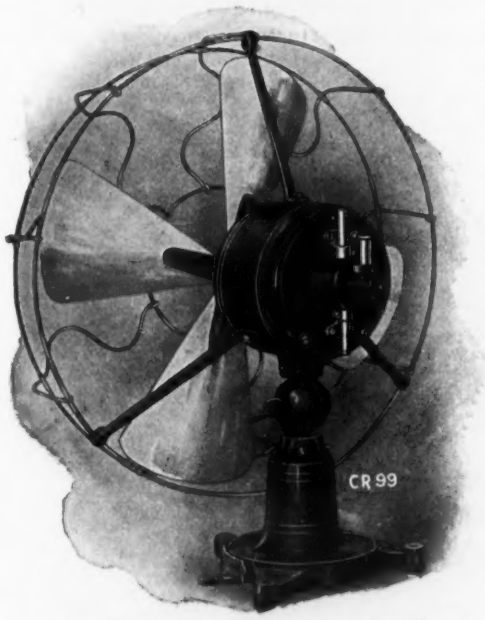


FIG. 2.—ROBBINS & MYERS "UNIVERSAL" FAN.

running. Fig. 2 shows the latest "Universal" type of fan, which is made in 12 and 16-in. sizes with a three-speed switch. By means of a double knuckle with serrated edges and thumbscrews the fan can be adjusted for direction of breeze and for desk or bracket use. The latest type of ceiling fan is shown in Fig. 3 with an electrolier attachment. The blades are of polished mahogany with a 58-in. sweep and run at 200 r.p.m. The fan has two speeds controlled by a switch. The motor is of a spherical shape of the usual bi-polar type with a deep slot armature. The bearings are of babbitt metal and are lubricated by means of an oil well carrying a year's supply of oil and revolving with the shaft. The spherical form of motor admits of the finish being directly electroplated on the castings forming the field rings and end plates.

Fidelity Direct Current Ceiling Fan.

The Fidelity Electric Company, Lancaster, Pa., has added to its line of fans a new type of ceiling fan shown in the accompanying illustration. The motor has a multipolar field cast in

FIDELITY CEILING FAN.

one piece, and the design of the laminated armature is such as to admit of a very thorough ventilation by the provision of air ducts. The lower bearing of the motor runs constantly in oil,

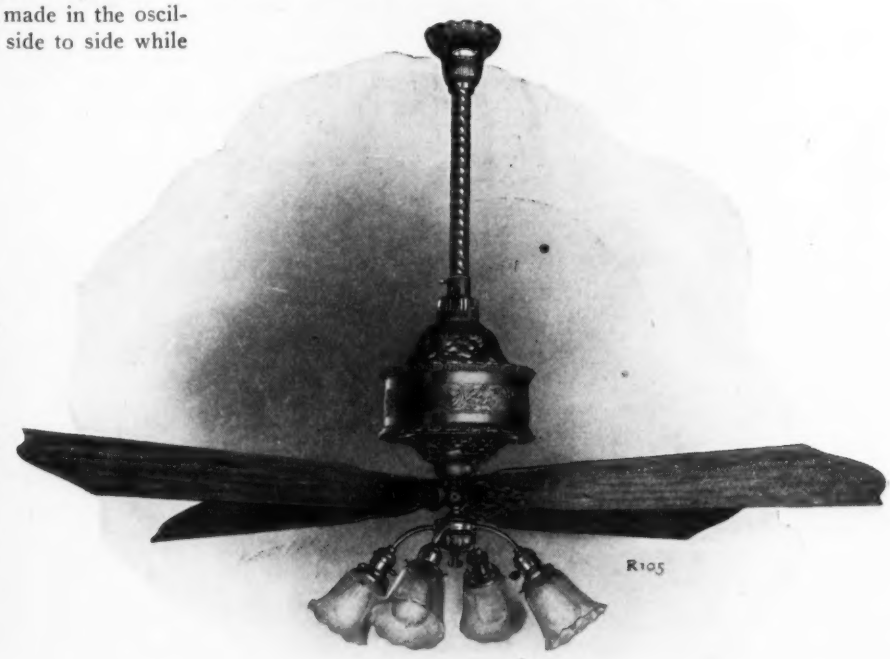


FIG. 3.—ROBBINS & MYERS CEILING FAN.

which is contained in a cup on the lower side of the fan. By unscrewing this cup the armature can be withdrawn without disturbing any of the other parts. The speed is 200 r.p.m. with four blades. The body of the motor is covered, as will be seen, with a metal band of handsome design. The top of the motor above is finished above the band in black Japan; on the lower side the oil reservoir and switch are covered with an ornamental iron cap finished in oxidized copper. The commutator is on the upper side of the motor, which obviates any chance of oil getting to it.

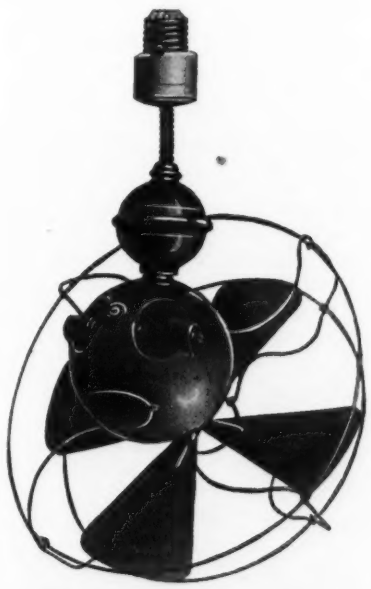
Beaver Battery Fan.

A battery fan motor outfit made by the Electric Motor & Equipment Co., Newark, N. J., is designed to meet the demand for an electric fan in places where electric current is not available. The fan motor weighs about 5 pounds and is equipped with a three-blade brass fan 7 in. in diameter. The four dry batteries for running the fan are contained in a neat wood box, the motor being placed on top of this and connection made by a flexible cord. The motor is provided with a switch for turning current on and off. It is stated that the batteries will run the fan continuously from 15 to 20 hours, or about 100 hours if used intermittently.

Fort Wayne "Wood" Fan Motors.

The line of fan motors manufactured by the Fort Wayne Electric Works last year consisted of four types: the desk, suspended revolving, bracket and telephone booth. These were all made with 8-in., four-blade fans. To these have been added this year a new line of 10-in., four-blade fans in the desk and bracket types. The same general construction has been followed in the new line of motors as in the old.

Both the direct and alternating-current motors have a spherical contour which gives the machine a very graceful appearance. The motor proper of this machine is exactly the same as that of the suspended revolving and bracket types. The field magnet is built up of stamped laminations which are individually japanned before being assembled. The field magnet coils are shellaced,



FORT WAYNE REVOLVING FAN.

baked and taped. The armature is of the familiar drum type with the discs twisted on the shaft so as to give the slots a slightly spiral course from end to end of the core. This is done to prevent humming. The commutator is separate from the armature, being assembled complete with its insulations and thoroughly baked before being finally finished and mounted on the armature shaft. The brushes are rectangular in cross-section and located in a brass tube in which they are fed toward the commutator by means of helical springs. Adjustment of the spring tension is provided by a screw set in the outer end of each brush tube. The bearings are self-oiling and are equipped with felt oil retainers.

The 8-in. motors run at a speed of 2,200 r.p.m. when subjected to the normal voltage. The direct-current motors require 17 watts; the low-frequency, alternating-current machines, 20 watts, and the high-frequency motor, 40 watts. The telephone booth type fan has a speed of 1,200 r.p.m. The 10-in. motors run at a speed of 1,700 r.p.m. and take approximately 32 watts.

General Electric Fan Motors for 1906.

As fan motor practice has become more or less fixed, the General Electric Company has concentrated attention on increasing the efficiency of the motors by embodying every electrical and mechanical improvement suggested by past experience.

Both direct and alternating-current fans have a special blade design, a positive trunnion adjustment, and perfect lubrication. In the design of the blades the end attained was that of distributing the air over a wide angle, not of delivering a straight

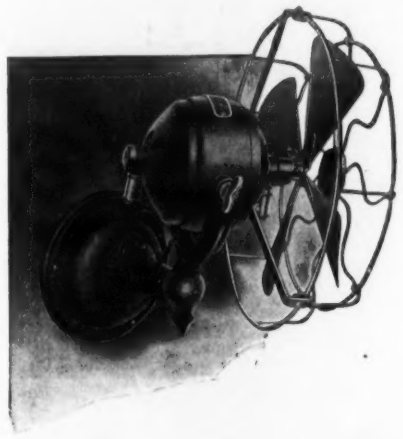


FIG. 1.—DIRECT-CURRENT WALL BRACKET FAN.

column of air covering a limited area, and a sure and positive trunnion adjustment permits the quick change of the breeze for either horizontal or vertical circulation, the position of the motor being always positively fixed by a notched clamp and thumbscrew. Wick oilers are provided which require no attention beyond the annual renewal of oil. The blades of the fans are carefully balanced and hung, thus insuring the elimination of disagreeable humming.

For frequencies of 60, 125 and 140 cycles the alternating-current type of fan consists of a single moving element without contacts, revolving in a ventilated cast iron field frame of

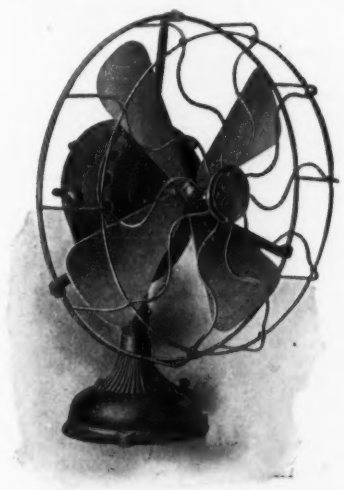


FIG. 2.—ALTERNATING-CURRENT DESK FAN.

compact design. Speed changes in the alternating-current motors are obtained by a six-point reactive coil and switch. The variation in speed so obtained makes the desk or wall bracket type of fan motor of universal application, as it may be operated on slow speeds for the office desk and home or on the higher speeds for stores and halls.

The direct-current fans have cast iron frame of elliptical form, with ventilated removable shields rendering the brushes, commutator and armature easily accessible. Rectangular brushes are used, giving the largest area of contact on the commutator

and an ingenious brush holder insures constant brush pressure on the commutator, keeping it polished and practically free from wear. Speed regulation is provided in the direct-current desk and wall bracket types by a self-contained four-point regulating switch and indestructible resistance, giving three speeds.

In addition to the regular desk and wall bracket types of direct and alternating-current fan motors, the General Electric Company also furnishes direct-current ceiling fans for either one

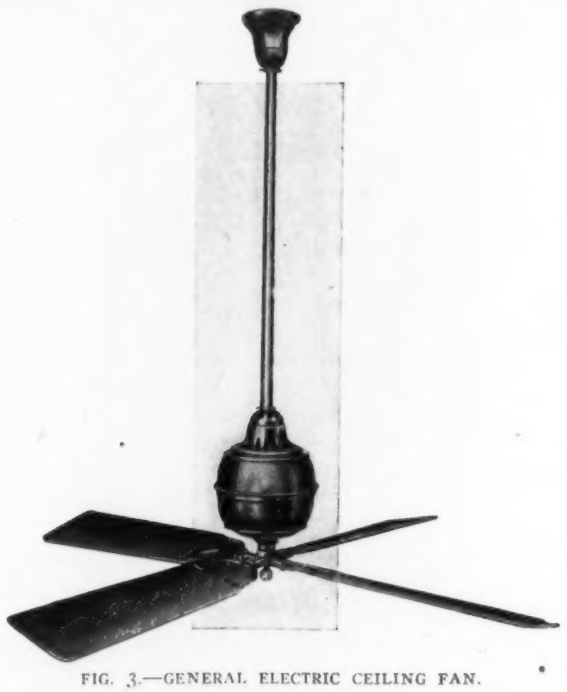


FIG. 3.—GENERAL ELECTRIC CEILING FAN.

or three speeds. These fans are ordinarily equipped with wooden blades, but are also furnished with aluminum blades for use in damp locations. In the three-speed fan the regulating device is entirely self-contained and operated by a button at the bottom of the fan.

For special ventilating purposes such as kitchens, hotels and restaurants this company supplies an exhaust type of fan motor

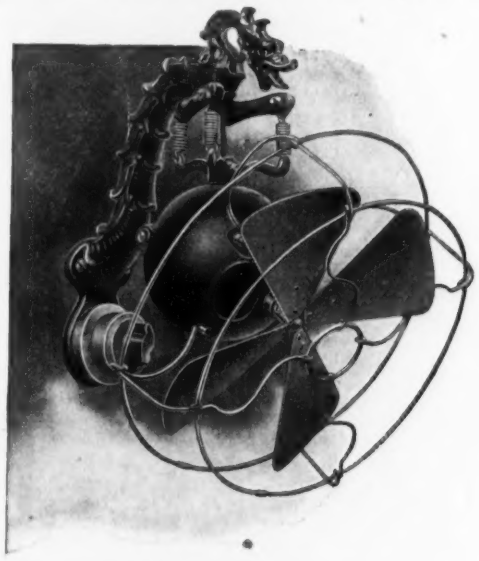


FIG. 4.—TELEPHONE BOOTH FAN.

for use on both alternating and direct current. These comprise the body of the swivel and trunnion type of the respective direct and alternating-current fans, mounted in a special bracket, as shown in Fig. 2, and adapted for suspension in windows, ventilating shafts, etc. Complete motor blower fans are made for ventilation purposes in mines and factories. Another type for both alternating and direct-current circuits is a compact little telephone booth fan motor.

Sterling Fans.

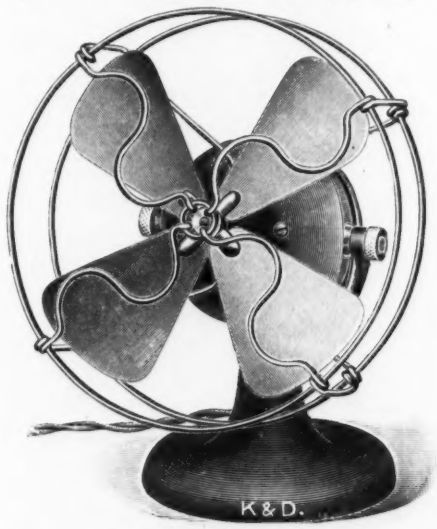
The Sterling Electrical Machinery Company, of Warren, Ohio, has put upon the market a new desk and bracket fan which embodies all the latest improvements in fan design. Since a well-ventilated fan, both as to armature and field coils, has a great advantage over an enclosed type, as it necessarily runs cooler and as a result will run longer, the Sterling fan is of the open field type. The armature is unusually well ventilated by means of open type hoods. The fans have three distinct speeds and a cut-out operated by means of a resistance in the base of the fan. The fan is made in two forms, both being of the swivel type adjusted by means of a thumb screw in the base. In addition one has a trunnion mounting.

Colonial Fan.

The direct-current type of oscillating fan made by the Colonial Fan & Motor Company, Warren, Ohio, has been entirely redesigned for the present fan season. The shifting vane, which actuates the simple rotating mechanism, is located inside the guard, thus removing possibility of injury from external causes. The fan body rotates on ball bearings. The switch, which is located in the base of the fan, affords two speeds, the higher of which is 1,350 r.p.m. for a 16-in. fan. Current from the main circuit is transmitted through brush holders to collector rings mounted on the bearing spindles, and leads to the motor are carried from these rings. By their use there is no possibility of lead wires wearing off in consequence of the oscillating movement. Switch, brush holders and collector rings are entirely contained within the base of the fan, being thus protected from dirt and injury. Brackets supporting the actuating vane are rigidly fastened to the guard, and these also carry the throwing lever. Among other 1906 Colonial fans are a swivel and trunnion type, and a new finish for ceiling fans.

Kendrick & Davis Battery Fans.

The accompanying illustration shows a battery fan made by Kendrick & Davis, Lebanon, N. H. As will be seen, the motor is practically of the enclosed type, the moving parts and windings thus being protected. The brushes and commutator, however, are exposed to inspection, so that any irregularity of per-



KENDRICK & DAVIS FAN.

formance due to worn-out brushes or dirt on the commutator, or any other cause, may be at once noticed and corrected. The bearings are of bronze. By means of a trunnion adjustment the fan can be tilted at any convenient angle. A switch is contained in the base. The diameter of the fan is 6 in. and the speed is 2,400 r.p.m. at 7 volts and ½ amp., the weight being 3½ lb. For operation 20 cells in multiples of 5 will give 200 hours or more of service.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Few signs of slackening trade were in evidence in wholesale trade and industry despite the wintry weather of the past week. The opening retail spring trade was somewhat affected by the weather conditions, but on the other hand crops have been benefited by the snow and rain. The coal strike situation is still in an unsettled state, although the belief is that a general suspension of all work will not occur. Jobbing trade at leading centers is large, and reorders for spring goods are already reported at western centers; collections are classed as fair to good; export trade is of a large mid-winter volume, and there are signs that lower prices of cereals have found response in improved foreign buying. The iron and steel mills are busily employed, and while new business is smaller in volume, there is a marked undertone of strength to this as to other metals, such as copper. Altogether, there is everything to indicate that the spring trade, present and prospective, will break all past years' records. Railway earnings were never better. January was deemed a record month, an increase of 19.4 per cent being reported, but February produced a heavier ratio of gain—25.6 per cent—and February's aggregate was only 4.7 per cent below that of January. The nearest approach to such a ratio of gain was recorded in November, 1897, the increase then being 21 per cent over November, 1896, when a decrease of 10 per cent was recorded. Comparing February, 1896, with the same month in 1906, shows that earnings have increased 50 per cent in the interval. Traffic has been heavy, and there seems to be an abundance in sight. Quietness still prevails in the market for pig iron. Consumption is heavy and production is slightly lower. The Bessemer market is in good condition, very little iron being available for early shipment. The tonnage on the book of some merchant steel interests is being reduced, and deliveries on plates are better. The steel-rail trade is in good condition; new orders are constantly coming out, while additional business is pending. Orders from trolley lines are a conspicuous feature. Large inquiries for structural material continue, and the prospects are for a further increase of business. Better deliveries are being made by eastern mills. Copper is firmer, but there is no general buying movement, though some business has been done for May shipment, and perhaps a little for June. Prices for lake and electrolytic were advanced another ⅛-cent during the week, which puts lake on the basis of 18⅝ and casting at 18⅜c. It is claimed that market conditions do not warrant the advance, but producers seem to be able to hold the gains as they are established. Demand for machinery and machine tools is good. *Bradstreet's* reports 187 business failures during the week ending March 15, as compared with 177 the week previous and 186 the corresponding week in 1905.

ROBERTS & ABBOTT'S NEW DEPARTMENTS.—The Roberts & Abbott Company, of Cleveland, Ohio, which for a number of years has been prominently identified with the electric railway industry as consulting electrical, mechanical and civil engineer, announces two other departments in addition to the recently-added hydraulic engineering department, giving a very wide range of operation. One is for industrial and architectural engineering, while the other is for fire prevention and protection. The first-mentioned department will be devoted to designing manufacturing plants and improving, altering and enlarging plants of that type already in operation. Herbert F. Stimpson, who has been placed in charge of the department, has had 24 years' experience in the designing of manufacturing buildings and has been connected with several large manufacturing establishments. The department of fire prevention and protection will devote its attention to designing buildings and installing special apparatus to provide adequate protection from fire. Mr. Houston Dunn, for ten years an inspector and adjuster of special hazards for one of the oldest fire insurance companies in the country, and for three years superintendent of the Philadelphia Fire Inspection & Protection Bureau, will be in charge of the department for fire protection. The Roberts & Abbott Company now has branch offices in the Maryland Trust Building, Baltimore, and 202 Walnut Place, Philadelphia, Pa.

COPPER REFINING PLANTS.—It is stated by the *Wall Street Journal* that the United Metals Selling Co., at its Raritan plant, is refining between 12,000,000 and 13,000,000 lb. of copper per month, but it is increasing its capacity 100 per cent, and by September 1 expects to be able to treat 25,000,000 lb. per month. A good share of the copper refining for the United Metals Selling Co. is done in Baltimore. The United States Smelting, Refining & Mining Co., which owns the Delamar plant at Cataract, N. J., will increase the capacity of its plant from 8,000,000 to 12,000,000 lb. per month by April 1. The American Smelting & Refining Co. recently increased the capacity of its eastern refining plant from 9,000,000 to 12,000,000 lb., and plans a further enlargement. The Nichols Chemical Co., owned by the American Metal interests, has a monthly refining capacity of 24,000,000 lbs. With the extension of these refining plants, there will be an excess refining capacity in the country. The copper production of this country, including Mexico and British Columbia, is at the rate of about 100,000,000 pounds per month, of which nearly 20,000,000 lb. is Lake copper which does not require electrolytic refining. With the enlargement of these plants the total copper refining capacity of the country will not be far from 100,000,000 lb.

SPOKANE POWER.—Mr. Jay P. Graves, of Spokane, has effected a consolidation of properties in which he was mainly interested. Among the roads which have been consolidated into one system are the Spokane & Inland, the Spokane & Coeur d'Alene, the Spokane Traction Co., and the Spokane Terminal Co. The Spokane & Coeur d'Alene was backed originally by Mr. Blackwell, of Spokane, who is president of the Howard Lumber Co., and controls large timber tracts in Idaho. It is about 100 miles long. The Spokane & Inland is under construction and runs down southeast from Spokane into the Palouse country. It is projected for a distance of about 140 miles, part of which is under construction. It will serve territory in which the Potatch Lumber Co. operates extensively. The Spokane & Inland will use electricity for its day traffic and expects to haul timber and lumber at night with steam power. It has a contract with the Washington Water Power Co. for electric power. The Spokane Traction Co. has about 13 miles of street railroad in Spokane. It receives its power also from the Washington Water Power Co.

POWER IN MEXICO.—Another power enterprise is reported from Mexico City; and it is stated that a syndicate of Chicago capitalists, represented by R. H. Springer, is having a survey made for an electric railway from the Cuernavaca line of the Mexican Central to the city of Chilpancingo. The syndicate has options on more than two million acres in the valley of the Rio Balsas. If these lands are purchased they will be colonized with American farmers. The current for operating the railway will be furnished from water powers in the region.

BERRIEN SPRINGS POWER.—A contract has just been executed between the council and the Berrien Springs, Mich., Power & Electric Company, of which C. A. Capin, of Chicago, is president, which means the erection in the village of a dam costing $1,000,000 in the St. Joseph River and an immense power house. The company gives the village 50,000 gal. of water daily and pays its indebtedness amounting to several thousand dollars. The dam will create a lake fourteen miles long.

THE DIEHL MANUFACTURING COMPANY has just completed the installation of an electrical equipment for a large manufacturing plant at St. Johns, P. Q., Canada. The plant consists of four 250-kw engine type generators running at 150 r.p.m., and one 100 kw at 260 r.pm. It includes also a 100-kw motor-generator set, and about 30 motors varying in size from 75 hp to 7½ hp.

CINCINNATI & COVINGTON TRACTION.—At its annual meeting held recently the Cincinnati, Newport & Covington Light & Traction Company decided to spend $175,000 in improvements, the greater portion of which will consist of additions to the electric light plant. A large turbine generator, a battery of 2,000 hp boilers, stokers and fuel-handling apparatus and a switchboard will be installed. Ten new cars will be purchased.

BAHIA, BRAZIL, TO BE ELECTRIFIED.—Guinle & Co., of Rio de Janeiro, Brazil, representatives of the General Electric Company, have closed a contract for the electrification of the tramway lines in Bahia, Brazil, and T. Guinle, of the firm, is now in the United States in connection with the project. The contract to the General Electric Company includes the machinery for the initial change-over. A new power house will be erected to contain a steam plant made up of Babcock & Wilcox boilers with Worthington condensers, furnishing steam to one 500-kw, 2,300-volt, three-phase, 60-cycle Curtis turbine of standard construction, and one 300-kw, 2,300-volt, 60-cycle Curtis turbine self-excited generator. Other station apparatus will include three 200-kw, 600-volt, direct-current generators driven by 300-hp, 2,080-volt induction motors, and three motor-generator sets, each consisting of a 150-kw, 600-volt generator driven by a 220-hp, 2,080-volt induction motor. The equipment contract also includes 40 miles of trolley line material, track bonding, etc., and motor equipments for thirty-six cars on each of which will be installed two-motor 40-hp equipments. The 300-kw Curtis turbine-generator is the first one to be shipped, built after the design of the self-exciting generator described in Mr. Alexanderson's paper before the recent meeting of the A. I. E. E.

WESTINGHOUSE RAILWAY ORDERS.—The railway department at the East Pittsburg works of the Westinghouse Electric & Manufacturing Company has received within the last few days some very extensive orders for electric railroad machinery. The Metropolitan West Side Elevated Railway Company, of Chicago, has ordered an equipment of 100 160-hp motors and 50 equipments of unit switch control. The same company ordered 52 motors of the same type only a month ago. The Bluffton & Marion Construction Company, of Bluffton, Ind., has contracted for a complete installation of electrical apparatus for a power house to operate an entire railroad, along with 32 50-hp motors. The Denver City Tramway Company has ordered 60 No. 101-F railway motors and the Pacific Electric Company has ordered 80 75-hp motors for an electric railway in Los Angeles, Cal. The largest order came from the Public Service Corporation of New Jersey for 378 motors, varying in capacity from 40 to 75 hp. These will be used to equip a number of new cars on the surface lines outside of Camden. This makes altogether contracts calling for 702 motors, and with the additional machinery included in these orders these contracts represent more than $1,000,000.

SHAWINIGAN POWER.—The statement is made in Boston that the Shawinigan Water & Power Co., whose securities are largely held in New England, will increase its income during the present year to the extent of over $100,000 by sales of additional power. The company was organized in 1898 to develop water power at Shawinigan Falls, Quebec, on the St. Maurice River, about 85 miles from Montreal. It is now selling 36,145 hp, and contracts coming in during 1906 will aggregate 9,300 hp additional, making a total of 45,445 hp, or approximately one-half the 100,000 hp capacity of the plant. Contracts in force show gross earnings of $324,333 per annum, and the additional power sold in 1905 will bring this total up to $433,783. It is estimated that the company will be able to show receipts at the rate of $500,000 before the close of the year. The company operates on the basis of about 13 per cent of gross, so that earnings of $500,000 should leave a balance of nearly $430,000 to meet the $200,000 interest on the $4,000,000 5 per cent bonds outstanding. The largest customer is the Montreal Light, Heat & Power Co., which has recently contracted to take 2,000 additional hp, making a total of 13,000 hp.

LARGE ADDITION TO SHOP.—In order to keep pace with its rapidly increasing business, the Power & Mining Machinery Co., Milwaukee, Wis., has awarded contracts for the erection of additions to their shops at Cudahy that will, when completed, more than double the present capacity. These improvements will cost upwards of $300,000, and will include a 200-ft. extension to their foundry, the installation of a considerable number of machine tools of special design, and an increase in its shop force of nearly 300 men, which will make the total number employed about 1,000. The present capacity of the plant is practically double what it was when the company acquired it, by purchase, from the Holthoff Machinery Company in 1903, but the business of the company has been increasing at such a rapid rate that its existing facilities have been found entirely inadequate, as it has been necessary for some months past to rely upon outside foundries for many of its castings. Excavating work has already commenced, and it is expected that the extension to the foundry will be completed early in June, at which time the new machinery will be installed.

STEAM TURBINE BUSINESS.—During the month of January, 1906, the Westinghouse Machine Company, East Pittsburg, Pa., entered orders for 22 steam turbines aggregating 56,500 brake hp in rated capacity, or an average of over 2,500 brake hp per turbine. Some of the largest orders were received from the United Electric Light & Power Company, New York, N. Y., 15,000 kw; New York, New Haven & Hartford Railroad Company, New York, N. Y., 11,250 kw; Louisville Lighting Company, Louisville, Ky., 3,000 kw; Oliver Iron & Steel Company, Pittsburg, Pa., 1,000 kw; West Virginia Pulp & Paper Company, New York, N. Y., 1,200 kw, and the Washington, Alexandria & Mt. Vernon Railway, 1,000 kw. The largest machines, going to the United Electric Light & Power Company, New York, N. Y., and will be 7,500 kw or 11,000 brake hp rated capacity. A 3,000-kw turbo-unit goes to Louisville, Ky., and three 4,500 brake hp units to the New York, New Haven & Hartford Railroad. The West Virginia Pulp & Paper Company already has two 1,000-kw units in service, and the recent order has resulted from the satisfaction given by the first installation.

ORDERS FOR ENGINES.—Appreciation of the Sturtevant engine has been shown by recent orders received by the B. F. Sturtevant Co., of Boston, Mass., from the Draper Company, Hopedale, Mass.; Illinois Central Railroad Co., Burnside, Ill.; Saginaw & Manistee Lumber Co., Williams, Arizona; Landers, Frary & Clark, New Britain, Conn.; Standard Ideal Sanitary Co., Port Hope, Ont.; San Diego Ice & Cold Storage Co., San Diego, Cal.; Continental Iron & Steel Co., Rahway, N. J.; Jones & Emmke, Sioux Fall, So. Dakota. Orders for economizers have recently been received from the Trimon Manufacturing Co., Roxbury, Mass.; Hamilton Powder Co., Beloeil, Montreal, P. Q.; Oliver Machinery Co., Grand Rapids, Mich.; Raritan Copper Works, Perth Amboy, N. J. The last named plant changed to the Sturtevant after experience with another type of economizer.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was extremely dull owing to the continuance of a firm money market and the uncertainty about the outcome of the coal labor situation. There was, however, a strong undertone, and breaks in certain stocks had little effect on the general list. The industrial group was also quiet, although the Steel stocks were firm, and a good impression was created by the corporation's annual report. There was some irregularity in Amalgamated Copper and other copper shares, which continued favorable reports about developments at the copper mines at Butte did not control. The market for electric stocks was devoid of any features and there was little activity. Allis-Chalmers common closed at 21⅞ and preferred at 59¾, these quotations being

NEW YORK

	Mar. 13	Mar. 20		Mar. 13	Mar. 20
Allis-Chalmers Co.	22¼	21	General Electric	169½	167
Allis.Chalmers Co. pfd.	58¾	57¾	Hudson River Tel.	...	...
American Dist. Tel.	37	30	Interborough Rap. Tran.	229	227½
American Locomotive	70⅝	69¼	Mackay Cos.	59⅛	59⅛
American Locomotive pfd.	116¼	116¼	Mackay Cos pfd.	74¼	74
American Tel. & Cable	92	92	Marconi Tel.	...	...
American Tel. & Tel.	138	136	Metropolitan St. Ry.	115	113
Brooklyn Rapid Transit.	84⅜	83¼	N. Y. & N. J. Tel.	...	...
Electric Boat	27	27	Western Union Tel	94¼	91
Electric Boat pfd	65	65	Westinghouse com.	161	161
Electric Vehicle	17	17	Westinghouse pfd.	...	...
Electric Vehicle pfd.	16	16			

BOSTON

	Mar. 13	Mar. 20		Mar. 13	Mar. 20
American Tel. & Tel.	139	137	Mass. Elec. Ry. pfd	69⅛	68¼
Cumberland Telephone	...	117¼	Mexican Telephone	...	...
Edison Elec. Illum.	247	...	New England Telephone	...	140
General Electric	...	...	Western Tel. & Tel	...	...
Mass. Elec. Ry.	20	20	Western Tel. & Tel pfd.	...	...

PHILADELPHIA

	Mar. 13	Mar. 20		Mar. 13	Mar.20
American Railways	51¼	51	Phila. Electric	...	7¾
Elec. Co. of America	11¾	11⅜	Phila. Rapid Trans.	30⅞	29⅛
Elec. Storage Battery	79	78	Phila. Traction	...	89¾
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Mar. 13	Mar. 20		Mar. 13	Mar. 20
Chicago City Ry.	170	150	National Carbon.	90	91
Chicago Edison	...	155	National Carbon pfd.	120	118
Chicago Subway	50	49	Union Traction	...	...
Chicago Tel. Co.	...	115	Union Traction pfd	...	...
Metropolitan Elev. com.	23½	25¼			

* Asked.

a net decline of ⅛ in the former and a net gain of ¾ in the latter. General Electric closed at 169, ex-dividend, a net gain of ¾ point, and Westinghouse at 161, an advance of ½ point. Among the tractions Brooklyn Rapid Transit made a net gain of 2 points, closing at 84⅜, while Metropolitan Street Railway

lost 2⅝, the last quotation being 113⅜. Interborough Rapid Transit (on the curb) closed at 226, which is an advance of 1 point. The closing quotation of Western Union was 93, a net loss of ¼ point; American Telephone & Telegraph 138½, a gain of 2 points; American Telegraph & Cable 92, a net loss of 1 point, and Mackay companies (on the curb) 59¼, a decline of ¾. The curb market was irregular and devoid of feature. Most issues were a little lower. Some of the copper stocks sold off one or more points on efforts to get out of long holdings. Herewith are the closing quotations on the Stock Exchange on March 20.

WESTFIELD, MASS., LIGHTING PLANT.—The annual report of the municipal lighting works department shows that the value of the gas plant is now $120,225 and of the electric light plant, deducting the depreciation required by statute, is $143,910. The depreciation deducted since the town began the experiment amounts to $47,725. The receipts, amounting to $60,883, are divided as follows: Sales of gas, $30,390; electric street lights, $12,079; commercial electric lights, $9,756; sales of lamps and materials, $1,606; electric power, $1,067. The expenditures, amounting to $49,963, included: operating expenses, gas, $19,948; electric, $14,485; interest, $3,150; bonds, $4,000; construction, gas, $3,369; electric, $5,011. The excess of receipts over expenditures was $10,919. The total gross profits are figured at $28,323, divided as follows: Gas department, $16,146; electric light, $12,067. Deducted from this amount are bills due and interest amounting to $7,606, leaving a net profit for the year of $20,717. The net profit, leaving out the depreciation required by the State, would be 10.81 per cent, but including the depreciation the profit is 6.91 per cent. The total number of gas consumers is now 1,019, an increase of 91. The electric light consumers, 136, an increase of 30. The output of gas for the year was 22,017,200 cubic feet. The electric power plant was conducted at a loss of $1,733, but more motors are now installed and a better showing the coming year is a certainty. The growth of the use of the prepayment meters is mentioned. The number is now about 100. The recommendations include a new lift at the large holder to cost $5,500, new meters to cost $1,000, new mains, $1,000.

BOILER COMBINATION.—It is now definitely understood, and may be authoritatively stated, that the Babcock & Wilcox Company has acquired the Stirling Consolidated Boiler Company. The officers of the controlling corporation decline to make public any statement on the subject, either in affirmation or denial, as the company is a private enterprise, and is not making any appeal to the public for capital in carrying out its plans. The chief interest in the Stirling Company hitherto has been, it is said, that of Mr. O. C. Barber, president of the Diamond Match Company, while the Singer Sewing Machine interests are prominent in the Babcock & Wilcox Company, whose New York Offices are in the Singer Building on Broadway, with factories at Bayonne, N. J. The Babcock & Wilcox Company's capital has hitherto been $3,000,000 with no bonded debt. It is more than likely that the two companies will be conducted under separate management, as distinct concerns, as hitherto, but with the underlying unified control. The Babcock & Wilcox Company has now had a prosperous existence of a quarter of a century, and has made American water tube boilers standard throughout the world. The production of the company was never so large as it is at present. Mr. J. Hollis Wells is the president of the corporation.

DIVIDENDS.—Directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable May 1. The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent each on the common and preferred stocks, payable April 2 to stock of record March 27. The directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent, payable April 16. The Southern New England Telephone Company's directors have declared the regular quarterly dividend of 1½ per cent, payable April 16. The Union Switch & Signal Company's directors have declared the regular quarterly dividends of 2½ per cent on the preferred stock and 2 per cent on the common stock, both payable April 10. Directors of the Westinghouse Air Brake Company have declared the regular quarterly dividend of 2½ per cent; also the usual extra dividend of 2½ per cent, payable April 10. The regular quarterly dividend of 1½ per cent has been declared by the Cincinnati Street Railway Company, payable April 1. The regular quarterly dividend of 1⅛ per cent has been declared by the Cincinnati Gas & Electric Company, payable April 1.

BARNEY & SMITH CAPITAL.—One of the largest builders of trolley cars, etc., is the Barney & Smith Company, of Dayton, Ohio, who since the abandonment of the proposed street car builders' consolidation have proposed to reincorporate and increase their capital. The new company, which is to be incorporated under the laws of West Virginia or Ohio, will issue, it is said, $2,000,000 of 5 per cent bonds, half to be used to retire the existing 6 per cent bonds and the balance as required for improvements and extensions. In addition to the $2,500,000 8 per cent preferred stock and $1,000,000 common stock issued by the existing company, $2,000,000 common stock will be put out and will be paid to the preferred stockholders in lieu of 36 per cent of deferred dividends. The reincorporated company will thus have a capitalization of $7,500,000, as follows: $2,000,000 5 per cent bonds, $2,500,000 8 per cent preferred stock, $3,000,000 common stock.

LIGHTING IN LOS ANGELES.—The Los Angeles Gas & Electric Company, in its annual statement, shows receipts from the sale of gas and gas products of $1,055,222.36, and from the sale of electric light and power, $577,740.55. The expenditures in the gas department were $1,202,383.78, and in the electrical department $461,617.95. The actual cost of its gas works is given at $4,751,892.52, with a present value of $4,731,359.95. The cost of the electrical power plant and the wiring system is placed at $2,019,296.52, with a present cash value of $1,930,914.94. The Pacific Light & Power Company, of Los Angeles, Cal., in its annual statement, places a valuation on its property of $5,088,647.08, the actual cost of which was $5,426,966.85. The total revenue of the company is given as $1,053,594.84. The cost for supplying heat, light and power outside of Los Angeles is $70,790.74, and that within the city is $459,997.30.

OTIS ELEVATOR showed for the year 1905 net earnings of $912,938, with preferred dividends of $339,697; common dividends, $127,006; depreciation, $246,235, and a total surplus at the end of the year of $1,600,000. President W. D. Baldwin, of the Otis Elevator Company, in his report to the stockholders, says: "If your company's business continues as prosperous as now indicated it is the intention of the directors to place the common stock on a 3 per cent basis, payable 1½ per cent semi-annually, the first payment to be made on October 15, 1906." The directors of the Otis Elevator Company anticipate that it may be wise in the near future to issue $772,000 preferred stock now in the company's treasury, to be offered to the stockholders pro rata at par. The company has purchased new property at Yonkers, Buffalo and Chicago and new buildings and extensions in several other places will be made.

WESTERN UNION TELEGRAPH earnings appear to be holding up this year in spite of the loss of the racing news business. The net revenue, partly estimated, for the March quarter is $1,500,000, and for the nine months $5,360,790. The surplus of the company last year, after the payment of the regular 5 per cent dividend, amounted to $1,092,000. This brought the total surplus up to $15,974,209. In spite of competition from different sources, the company is able to show earnings well in excess of its interest and dividend requirements. For the past three years reported in full, the net earnings showed a tendency to decrease, but in the present year the decrease has apparently been checked.

KENTUCKY TELEPHONE DEAL.—The Central Telephone Company has been organized to take over the Louisville Independent Long-Distance and all smaller companies in Owensboro, Lexington, Maysville, Paris, Eminence and sections near these points in Kentucky. Southern Indiana will also be included. The Central Telephone Company was recently incorporated in the State of Delaware with a capital stock of $10,000,000. E. L. Barber, who was identified with the building of the Louisville Home Telephone Company, is president of the new concern.

U. S. LIGHT & HEATING.—The control of the United States Light & Heating has been obtained by interests connected with the New York Air Brake Company. While the new management of the United States Light & Heating Company is practically the same as that of the New York Air Brake Company, the latter has no interests, as a company, with the Light & Heating Company.

MUTUAL ELECTRIC LIGHT PLANT SOLD.—It is reported that negotiations have been practically completed for the purchase of the Mutual Electric Light Company, of San Francisco, Cal., by the Pacific Gas & Electric Company. The terms of the deal have not been announced, but Mutual stock has advanced to $19.25.

GENERAL NEWS.

Construction News.

OPELIKA, ALA.—The Opelika Railway, Light & Power Company has, after a lapse of some time, again started work on an electric line from Opelika to Auburn, Ala. The franchise includes besides the street railway a light and power plant.

BIRMINGHAM, ALA.—The City Council of Avondale has granted the Birmingham Railway, Light & Power Company the franchise on Third Avenue from the eastern city limits to the western limits for its new line. The new 3000-kw turbine of the company has been placed in service.

GADSDEN, ALA.—The Independent Telephone Company, which secured a franchise in this city several months ago, has commenced work upon the construction of its system. The Southern Bell Telephone Company also has a large force of men here at work putting in improvements to the extent of about $30,000.

DOTHEN, ALA.—Contracts for the municipal electric light plant, to cost about $10,000, have been awarded as follows: To the Crocker-Wheeler Company, of Ampere, N. J., for dynamos; the Harrisburg Machine & Foundry Company, Harrisburg, Pa., for the engines, and the Adams-Bagnall Electric Company, of Cleveland, Ohio, for the alternating-current arc lamps.

BISBEE, ARIZ.—In all probability the Consolidated Telephone & Telegraph Company will extend its system which will place Bisbee in position to communicate with Los Angeles and Denver.

STUTTGART, ARK.—The Stuttgart Water & Electric Light Company has been overhauling its plant. La Salle Stoops is manager.

SILOAM SPRINGS, ARK.—The Municipal Electric Light & Water Company is contemplating putting in larger engines and dynamos. R. L. Neely is superintendent.

SUSANVILLE, CAL.—James Branham has secured a franchise for an electric light plant.

SAN DIEGO, CAL.—The Pacific Mutual Light & Power Company has decided to construct a gas and electric light plant. I. C. Woodward, of Los Angeles, is one of the directors.

SAN FRANCISCO, CAL.—The Northern California Power Company has decided to construct a new power line from Volta to Chico and Hamilton. Address E. V. D. Johnson, of Redding, Cal., for further information.

LOS ANGELES, CAL.—It is understood that the Tia Juana and Cuyamaca dummy lines are to be rebuilt and electrified in connection with the work of the recently incorporated Los Angeles & San Diego Beach Electric Railway Company.

LOS ANGELES, CAL.—J. A. Kurtz, chief engineer of the Los Angeles Railway Company, has made a formal proposition to the citizens of Glendale and Verdugo to run an electric line from this city to Verdugo Park, a distance of more than 10 miles.

SAN DIEGO, CAL.—San Diego Consolidated Gas & Electric Company is installing a 1500-kw Curtis turbine, 1000 hp additional in Babcock & Wilcox boilers, and a 24-inch conduit to the bay, 1800 feet in length, for salt water for condensing purposes.

POMONA, CAL.—The directors of the local Home Telephone Company have re-elected Dr. F. W. Thomas president; J. Albert Dole, vice-president; Arthur M. Dole, secretary; Charles E. Walker, treasurer, and D. S. Parker, manager for the ensuing year.

MONROVIA, CAL.—An addition to its building on Myrtle Avenue, the most improved switchboard, cables to replace open wires and general improvements of the Monrovia branch are contemplated by the Home Telephone Company at cost of $10,500.

PASADENA, CAL.—Heman Dyer, City Clerk, writes that the City Council has passed a resolution, providing for the issue of $125,000 bonds for the construction of an electric light plant. An election will probably soon be held to vote on the question.

LAKEPORT, CAL.—The Lake County Power Company has been incorporated, with a capital of $10,000,000 to generate and sell electricity in Lake and other counties in California. The company will also manufacture and sell ice. The directors are Wilber T. Mariner, Herbert V. Keeling, M. S. Sayre and others, all of Lakeport.

FIELDS LANDING, CAL.—The North Mountain Power Company has applied to the Board of Supervisors at Eureka for a 50-year franchise to erect and maintain poles, masts and superstructures on which to suspend wires and other appliances for transmitting and conducting electricity for heat and light and power purposes along the streets, alleys and roads of the town of Fields Landing. Bids for said franchise will be received by the Board of Supervisors April 9. J. S. Brown, Chairman.

SAN FRANCISCO, CAL.—Under a contract made for twenty years with the United Railroads about thirteen months ago, the California Gas & Electric Corporation has begun to supply electric power to the street railway company. About 3000 hp is now being supplied daily, and in a couple of months when the power house just over the line in San Mateo County is finished, the California Gas & Electric Company will be able to supply a maximum of 12,000 hp. The latter will only be required during the hours of the day when the travel is heaviest. The average power will be about 6,000 a day.

COLUSA, CAL.—It is stated that it is the purpose of the California Gas & Electric Company in the future to depend upon Butte County as its most reliable and principal source of electric power. This is due to the fact that within this county the water supply has been unfailing, a condition which did not exist in other sections where the company has extensive plants. The company is now arranging to establish two additional generators of 8,000 hp each in Butte County—one each at Centerville and Da Sabla—and will also install two more in Nevada County, at Colgate and Deer Creek. The work which is now being done in the neighborhood of Centerville is toward this end. In addition to the water-power plants where the company is arranging to install several gasoline engines of 5,500 hp in the large cities, to be held for emergencies such as failure of water supply or breakages on the transmission lines. The company is now engaged in putting in a transmission line in one of the coast counties which is to furnish under a twenty-year contract 7,000 hp for a large cement works.

COLORADO SPRINGS, COL.—Henry Jameson, of Indianapolis, Ind., is said to have been elected president of the Animas Power & Water Company which proposes constructing a power plant on the Las Animas River, to cost about $1,000,000.

MONTROSE, COL.—The United Lighting & Traction Company has bought control of the Montrose Electric Light & Power Company, Montrose, Col. The officers are: President, W. S. Iliff; vice-president, C. K. Durbin, Denver; manager, S. B. Richey, Montrose.

JEWETT CITY, CONN.—It is understood that plans are being discussed for making improvements to the local electric light plant.

WILLIMANTIC, CONN.—Superintendent Moulton, of the water works, has recommended that an electric light plant be installed at the pumping station for lighting the station.

STAFFORD SPRINGS, CONN.—The Stafford Springs Electric Light & Gas Company's plant was sold by the receiver for $10 above the amount of the mortgage or bonds, to W. T. Hincks, of Bridgeport. The plant will be improved and put in condition to render satisfactory service.

BRANFORD, CONN.—Superintendent Baldwin of the Branford division of the Consolidated Light & Water Company has been notified by General Superintendent Calvert that on and after April 1 the price of electricity for Branford will be reduced from 18 cents per kw-hour to 15 cents. It is expected that this reduction will greatly increase the number of consumers.

WILMINGTON, DEL.—Bids will probably soon be asked by the Wilmington Heat, Light & Power Company, for a power plant on the Brandywine River, in the 9th ward.

WASHINGTON, D. C.—Bids will be received until April 20 by the Department of Agriculture, of which James Wilson is secretary, for furnishing electrical supplies, etc.

WASHINGTON, D. C.—Bids will be received until April 10 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards at Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies, as follows: Schedule 116, iron bolts; circuit breakers, voltmeters, ammeters, dry battery cells, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. A.

TAMPA, FLA.—A project is on foot to construct an electric railway across the peninsula from this city to Santa Lucia.

HAWKINSVILLE, GA.—The Hawkinsville Cotton Mill will install a 150-kw generator some time this summer; also about a 200-hp engine. W. N. Parsons is president.

ATLANTA, GA.—The Georgia Railway & Electric Company has petitioned the Board of County Commissioners for permission to lay either a single or double track along Stewart Avenue to Dill Avenue.

ROME, GA.—Work on the new power plant of the City Electric Railway Company in New Rome has been commenced. The plant will be in operation about August 1 and will cost $60,000. The old power plant will be sold.

CARTERSVILLE, GA.—Joseph B. McCrary, Empire Building, Atlanta, will prepare estimates for the construction of an electric light plant. The question of issuing bonds for same will probably be submitted to the citizens in sixty days. George S. Cobb is chairman of the Lighting Committee.

ALBANY, GA.—The town having been successful with municipal ownership of the electric light and water systems, it is now said to be negotiating for the electric railway system. A committee has been appointed to gather data in regard to the matter. It is believed that the city will not sell a franchise, but will proceed with the work itself as it did in the case of the other plants.

COLUMBUS, GA.—The newly organized Columbus Power Company, with a capital of $5,000,000, is perfecting its plans for the construc-

tion of a 3,000-hp plant on the Chattahoochee River between Columbus and West Point. The plans include a further development next year of an additional 4,000 hp. Later the company expects to develop 15,000 hp more at Clapp's factory, two miles north of the city, where the Chattahoochee River falls over 40 ft.

MAUI, HAWAII.—At a meeting of the Maui stockholders, Superintendent E. B. Carley's report for the expenditure of $2000 for improvements was adopted. Among other things this includes the building of two new lines to Hamakuapoke and Makawao and general line work.

CULDESAC, IDA.—The Culdesac Milling Company is preparing to make a test of the water power site which it owns, with a view to establishing an electric lighting plant.

POST FALLS, IDAHO.—The residents of the south side of the river are about to construct a telephone line. A company will be formed and will probably be incorporated.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company has doubled its output in two years. It will soon be enlarged, the present equipment being doubled throughout. D. C. Van Buren is manager.

DEKALB, ILL.—The electric power plant of the Haish Manufacturing Company of this city was destroyed by fire. Loss, $15,000.

CAMERON, ILL.—The Rock Island-Southern Railway Company has commenced work on the construction of its new power house.

UPPER ALTON, ILL.—At a meeting of the Star Telephone Company the capital stock was increased from $10,000 up to $25,000.

ALTON, ILL.—The Alton Gas & Electric Company has decided to expend $50,000 in making extensions in Alton and Upper Alton.

MT. CARROLL, ILL.—The Mt. Carroll Telephone Company has applied for a franchise to construct telephone lines in and around Mt. Carmel.

PEORIA, ILL.—Plans for the big power plant to be erected by the McKinley syndicate in this city have been prepared. The estimated cost is $400,000.

CARROLLTON, ILL.—The Carrollton Heat, Light & Power Company contemplates installing a 150-kw, direct-connected, two-phase, 60-cycle unit. F. M. Sinsabaugh is manager.

QUINCY, ILL.—Representatives of the Pittsfield (Ill.) Electric Light Company are said to be considering plans for establishing an electric light plant somewhere in the natural gas district of this city.

SULLIVAN, ILL.—The City Light & Water Works is making an estimate preparatory to enlarging its lighting plant, the improvements to include a Corliss engine and two alternators. The estimated cost is $35,000.

EAST ST. LOUIS, ILL.—It is stated that a number of improvements are contemplated in the rolling stock and power houses of the East St. Louis & Suburban Railway and the St. Louis, Alton & Granite City Railroad.

ATLANTA, ILL.—The Atlanta Electric Light & Power Company is enlarging its power house and installing another 100-hp boiler and replacing all the old open arcs with enclosed arc lamps. J. C. Robinson is secretary and manager.

CADIZ, IND.—Plans are being made to construct an electric light plant for Cadiz.

MUNCIE, IND.—The Delaware Hotel Company is preparing to install an electric light plant in its new hotel now nearing completion.

CANNELTON, IND.—The City Council and the electric light board concluded to rebuild the electric light plant recently destroyed by fire.

OAKLAND CITY, IND.—A 25-year franchise has been granted to Charles F. Stevens to operate a telephone exchange at Oakland City in competition with the Cumberland Company.

INDIANAPOLIS, IND.—Bids will be received by the Board of Park Commissioners on March 30 for incandescent lighting in the parks of the city. There are a large number of lights in the parks.

FAIRMOUNT, IND.—The Fairmount Light & Power Company proposes to install meters for all consumers and to give a continuous service, using an American Diesel engine. Paul La Rue is superintendent.

LINTON, IND.—The City Lighting Company is likely to pass to private ownership. It is possible that the city may retain a certain amount of stock. There are three purchasers in the field. J. J. Powell is superintendent and manager.

FORT WAYNE, IND.—It has been decided by the directors of the Fort Wayne & Wabash Valley Traction Company to build a line through Delphi, connecting Lafayette and Logansport and also to extend the Battle Ground line to Monticello.

LIBERTY, IND.—Charles L. Henry, of Indianapolis, president of the Indianapolis & Cincinnati Traction Company, in company with his chief engineer, was in Liberty recently looking over the line for the extension of the road from Connersville to Cincinnati.

RICHMOND, IND.—E. C. Meade & Co., consulting engineers of Dayton, O., have completed plans for the improvement of the municipal electric light and power plant for the city of Richmond. Bids for the new equipment will be asked for as soon as the plans are accepted.

NOBLESVILLE, IND.—The S. M. Smith Company has sold its plant to the Noblesville Heat, Light & Power Company, which intends to rebuild the plant and put it in first-class condition. The new company, which is capitalized for $50,000, is composed of Kokomo and Indianapolis capitalists.

INDIANAPOLIS, IND.—The Indianapolis & Ohio Valley Traction Company desires to let contracts, if possible, by April 1. Contractors wishing to bid on this construction can correspond directly with the Indianapolis & Ohio Valley Traction Company, 403-406 State Life Building, Indianapolis, Ind., where plans, profiles, etc., are on file.

NAPPANEE, IND.—An election will be held in Turkey Creek township on April 20. Petitioners are asking that subsidies of $10,000 from Turkey Creek, $7000 from Van Buren and $4,000 from Jefferson townships be voted to the new traction line, which will be known as the Fort Wayne & South Bend Air Line Traction Company.

TERRE HAUTE, IND.—It is said that the board of public works has signed a five-year contract with the electric company to light the streets of the city. This act surprised the Council and the Mayor, who had planned to secure a one-year contract and then go ahead with the plans for a municipal plant in compliance with the popular vote of the people last fall. The Council is inclined to let the contract stand, although a majority is favorable to a municipal plant.

CHICKASHA, I. T.—The City Council has granted the City Street Railway Company, a franchise for an electric light plant.

COLGATE, I. T.—Frank V. Archer, of Muskogee, is reported to have secured a franchise for an electric light plant and street railway.

NOWATA, I. T.—The town is considering a grant to Mr. W. A. Davis of a franchise for a lighting plant. If the franchise is granted work on the plant will commence at once.

DAVIS, I. T.—The Commonwealth Trust Company, of St. Louis, Mo., is said to have acquired a controlling interest in the Oklahoma City, Lexington & S. S. Electric Railway and has arranged to carry out the plans as originally proposed by the former promotors.

AFTON, IA.—The city of Afton has bought an electric light plant for $2,950.

ALBIA, IA.—A. R. Jackson has been voted a franchise for a heat, light and power plant.

OTTUMWA, IA.—At the recent public meeting it was voted to accept the proposition of the Indiana syndicate regarding the building of an interurban line from Ottumwa to Des Moines.

TAMA, IA.—The Toledo Commercial Telephone Company is making improvements in the local system, which include a new switchboard and the erection of 5,000 ft. of new cable.

CLINTON, IA.—The Clinton Street Railway Company has been organized to succeed the State Electric Company, and the capital stock has been increased to $600,000 and the funded debt to $400,000. The company has changed the name of its park from Joyce Park to Eagle Point Park.

FAIRFIELD, IA.—The Fairfield Brick & Tile Company is asking a franchise for an electric power, light and heat plant, which will be voted upon on March 26. The town now has a municipal plant. William L. Long is superintendent.

ACKLEY, IA.—The Ackley Electric Light, Heat & Water Works proposes to install a 125-hp engine, direct-connected to two 110-volt generators of about 50-kw each. Also one or two 66-in. x 16-ft. high-pressure boilers in the near future. H. H. Nazett is superintendent.

OSAGE CITY, KAN.—W. C. White, city clerk, writes that the citizens voted March 16 to issue $15,000 bonds for improving the electric light plant.

OSKALOOSA, KAN.—The Oskaloosa Electric Light Company, which is now entering the fourth year of a successful career, is completing a circuit for street lights. A 50-hp Ideal engine and 30-kw Westinghouse alternator, 1,000-110 volts, are now loaded to full capacity. The rate charged is 15 cents per kw, with a monthly minimum of $1.50. Jay S. Buck is manager.

MONTICELLO, KY.—An electric light plant is being installed here and will be equipped with direct-current apparatus.

CLOVERPORT, KY.—The City Council has granted to H. Stewart Miller, Jr., of Owensboro, a franchise for an electric light plant here.

OWENSBORO, KY.—The plant of the Kentucky Electrical Company on Lewis Street is reported to have been destroyed by fire on March 8.

FULTON, KY.—The Fulton Electric Light & Power Company has been reorganized with the following officers: President, L. W. Graham; secretary, E. C. Robinson; treasurer, J. V. Hefley.

SPRINGFIELD, KY.—The Springfield Water & Electric Light Company is installing new machinery in its plant in order to provide for the supply of new lines which it will build at once.

SOMERSET, KY.—The Somerset Water, Light & Traction Company has commenced grading for its street railway, and will also reconstruct its wiring system for furnishing electric light and power.

HICKMAN, KY.—The Hickman Coal & Ice Company has leased the municipal water and light plant for twenty years and will run it in connection with its ice plant. A new outfit of machinery will be installed. A. B. Hughes is superintendent.

MORGANFIELD, KY.—The Morganfield Light & Power Company recently installed a 200-hp engine, 120-kw alternator with switchboard, 100-hp boiler, and has closed a contract for 30 arc lamps, to run all night every night. The plant has been in operation 12 years, but these will be the first street lights.

NEW ORLEANS, LA.—An ordinance has been introduced into the City Council, granting to Charles B. Stark the privilege of constructing and maintaining a telephone system in this city. The system must be completed within three years and have a sufficient capacity to serve 3,500 subscribers.

NEW ORLEANS, LA.—E. L. Powell, superintendent of the Cumberland Telephone & Telegraph Company, has presented in writing to the City Council an offer from the company to pay the city 3 per cent of its gross earnings so long as it has no competition. It is estimated that this will amount to not less than $12,000 per annum.

DONALDSONVILLE, LA.—At a special meeting of the City Council the Westinghouse Electric Company, of Pittsburg, Pa., was awarded the contract to furnish fifteen Westinghouse copper-case, inclosed arc lamps, with a 50-light transformer, etc., for $795. This equipment is to be used in illuminating Mississippi Street and Railroad Avenue. Other bidders were the General Electric Company, of New Orleans, and the Fort Wayne Electric Company of Fort Wayne, Ind.

PITTSFIELD, ME.—The citizens of Pittsfield are agitating the question of establishing a municipal electric light plant.

PORTLAND, ME.—The Portland Electric Lighting & Power Company has decided to construct a new brick power house here this spring.

LIVERMORE FALLS, ME.—The Maine Telephone & Telegraph Company has filed articles of incorporation, with a capital stock of $25,000.

BATH, ME.—The City Council has completed a contract with the Sagadahoc Light & Power Company for lighting the city for a term of five years.

LEWISTON, ME.—At the recent town meeting it was voted to make a contract for five years with the electric light company for lights not to exceed $75 per arc light.

ELLSWORTH, ME.—The Bar Harbor Union River Power Company suffered considerably during the late storm, which was the severest of the winter. Power and lighting service were both seriously interrupted for a few hours.

BANGOR, ME.—Jesse G. Waters, Danvers Cram and Arthur D. Mansell were appointed a committee to make a contract with the Newport Light & Power Company for street lights for the ensuing year. It is said that some of the arcs are to be removed and incandescent lights substituted.

BRUNSWICK, ME.—Superintendent Hopkins, of the Brunswick Electric Light & Power Company, states that after the recent storm the wires were in a worse condition than at any time during the fifteen years he has been employed by the company. One night the plant was practically shut down.

BALTIMORE, MD.—The County Commissioners have been asked to furnish a dozen or fifteen additional arc lamps in Violetsville in the Thirteenth District..

ARLINVILLE, MD.—The City Council has agreed to grant Senator W. L. Mounts an incandescent light franchise, and with it the gas franchise is also to be renewed.

TOWSON, MD.—The County Commissioners have awarded to the Mt. Washington Electric Light & Power Company the contract for lighting Roland Park, Evergreen Park and Tuxedo Park. T. W. Offutt is president.

RICHPORT, MASS.—A committee has been appointed to investigate the feasibility of establishing a municipal lighting plant.

HOPKINTON, MASS.—At a recent town meeting a committee was appointed to investigate the question of an electric light plant.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company is expecting to install a 2,000-kw engine and generator, direct-connected, and two B. & W. boilers of 400-hp each.

WHITMAN, MASS.—It was voted at a recent town meeting to either purchase or construct an electric light plant and a committee was appointed to investigate and report upon the matter.

BROCKTON, MASS.—The question of municipal ownership of the gas and electric lighting plants is being considered by the City Council, and it is considered probable that the systems will be taken over by the city.

MIDDLETON, MASS.—The following committee was chosen to investigate the matter of installing electric incandescent lights for street lighting, etc.; S. S. Merrill, M. J. Emerson, L. G. Esty, B. T. McGlauflin, H. K. Richardson.

ABINGTON, MASS.—There seems to be but little doubt that the stockholders of the Abington & Rockland Electric Light & Power Company will sell its interests to Stone & Webster, who control the Edison Electric Illuminating Company

FALL RIVER, MASS.—The contract for constructing the foundations for the new power house of the Fall River Electric Light Company, to be erected on the wharf at the foot of Hathaway Street, has been awarded to Beattie & Wilcox.

MANSFIELD, MASS.—The demands for business at the electric light plant have increased so rapidly that it has been found necessary to increase its capacity. The Council has been asked for an appropriation to install another 225-hp unit.

ORANGE, MASS.—The Orange Electric Light Company during the summer months will put in two new three-phase generators, enclosed arcs and a new steam plant in the building with its water plant, located at Wendell Depot, Mass. E. O. Horton is manager.

BEVERLY, MASS.—The Beverly Gas & Electric Company is installing a 500-kw Curtis turbine, 300-hp B. & W. boiler and Wheeler condensing apparatus; will put in new storerooms, and is starting an energetic canvass for new business. A. Macaulay is superintendent.

MILFORD, MASS.—At the adjourned town meeting recently the vote was taken authorizing the selectmen to contract for street lighting for one year with the Milford Electric Light & Power Company for 58 arc electric lights, the cost not to exceed $90 each, and for 150 gas mantle lamps at $24 each.

FITCHBURG, MASS.—At the offices of the Fitchburg Gas & Electric Light Company, contracts were signed which mean the doubling of the present electric plant of the company. The increase in production of power will be from 1,000 kw to 2,000 kw. The contracts are for Mackintosh & Seymour engines of 1,500 hp, and a General Electric Company alternating-current generator of 1,000 kw, all of which is to be installed before January 1, 1907.

WORCESTER, MASS.—The statement is made here that John Farson, of New York, representing a western syndicate, has been inspecting street railway propositions beginning with the Worcester & Holden and including those in the vicinity of Gardner, Westminster, Fitchburg and Leominster, besides prospective connections with Lowell. The suggestion is made that the syndicate is looking for a route into Boston by way of Lowell, although a new route between Fitchburg and Boston has been talked of by promoters for some months.

MONROE, MICH.—Improvement to the amount of $50,000 are planned for the power plant at this city.

HOMER, MICH.—The Homer Telephone Company has completed arrangements for increasing its capital stock from $15,000 to $30,000.

SHEPHERD, MICH.—The Michigan State Telephone Company has authorized the expenditure of $1,000 for improvements to the local system.

IRON RIVER, MICH.—Charles A. Otto, village clerk, writes that the citizens voted March 12 to issue bonds for the construction of an electric light plant.

LINDEN, MICH.—Warren S. Rundell, of Flint, has made a proposition to the Village Council to light this village from the electric plant at Fenton.

HARBOR SPRINGS, MICH.—The municipal plant will put in a 100-kw alternator to replace the present 37½-kw machine. Harry L. Metz is superintendent.

NORWAY, MICH.—Extensive improvements are contemplated by the Bell Telephone Company in its telephone system here. The company will spend about $10,000.

MOUNT PLEASANT, MICH.—Improvements and extensions in the local telephone system to the amount of $3,000 are planned by the Michigan State Telephone Company.

SAGINAW, MICH.—The Council on request of the Central Labor Union decided to submit to the voters April 2 a proposition to issue bonds for a $150,000 municipal light plant.

DETROIT, MICH.—H. W. Noble & Co. have sold the Dunkirk & Predonia Electric Railway to a strong syndicate of Eastern capitalists, who have also bought up the Buffalo, Dunkirk & Western.

LANSING, MICH.—The Capital Electric Engineering Company has purchased the stock and interests of the Van Gorder Electric Company, and F. E. Van Gorder has accepted a position as superintendent.

BLISSFIELD, MICH.—The annual report of the municipal electric light plant shows an expenditure for 1905 of $4,678.83, and a profit of $213.85, excluding 34 arc lamps and some incandescents on the streets, for which no charge is entered.

BATTLE CREEK, MICH.—The Battle Creek & Southeastern Electric Railway Company, which proposes to build from Battle Creek to Cold Water, announces that it has secured a 66-foot right of way for the entire distance. The company proposes to buy its power.

ANN ARBOR, MICH.—There will be a direct railway between Ann Arbor and Adrian by the extension of the Saline branch to Tecumseh. Ten miles of this road will be built as soon as spring opens. The power for the new line will be furnished by the Ypsilanti power house.

HART, MICH.—The Village Council has voted to submit to the people the question of issuing bonds for $20,000 for the purpose of putting in an electric light plant. Hart has been considering the municipal lighting question for some time. A proposition from the Pere Marquette Company has been under advisement.

BERRIEN SPRINGS, MICH.—The village has made a contract with the Berrien Springs Power & Electric Company, which will commence building a dam in the spring. The company will give the village power free forever to light 25 arc lights, pump 50,000 gallons of water free daily for the use of the village and sell electric current to commercial users at a rate of 20 per cent. lower than the price in South Bend.

SAGINAW, MICH.—The Detroit, Flint River & Saginaw Valley Railway Company has been granted a franchise in Flint and will construct an electric railway from Saginaw to Fenton via Flint. The road will be built by two companies—the Fenton, Long Lake & Flint line and the Saginaw-Flint line. W. F. Davidson, of Port Huron, is the president of both; D. D. Aitken, vice-president; E. D. Black, secretary, and Arthur Bishop, treasurer.

COTTONWOOD, MINN.—The Home Telephone Company will extend its rural lines.

AUDUBON, MINN.—A local telephone exchange is projected. A. O. Netland is interested.

LAMBERTON, MINN.—A company will be formed to install a local telephone exchange. Albert H. Enerson is interested.

NEW ULM, MINN.—The New Ulm Rural Telephone Company will build 50 miles of pole lines. The switchboard will also be enlarged.

MARSHALL, MINN.—The city will install new machinery in its lighting plant this summer, having outgrown its old equipment. E. Simmons is superintendent of the plant.

DAWSON, MINN.—The electric light plant will install a 125-hp engine this summer and an 80-kw direct-current machine, and will extend its pole line. The cost will be about $8,000 in all.

DULUTH, MINN.—The Mesaba Telephone Company will immediately begin the construction of a building for a telephone exchange and offices. The company expects to have the building ready for occupany by Fall.

NORTHFIELD, MINN.—Charles E. Church is arranging to install a new telephone exchange in this city to be known as the Northfield Rural Telephone exchange. It is to be operated in connection with the new Faribault rural lines and the Tri-State long-distance lines.

LEXINGTON, MISS.—The Board of Mayor and Aldermen are considering the question of issuing $25,000 bonds for an electric light plant.

WEATHERSBY, MISS.—The Board of Aldermen has granted a franchise to Ware & McInnis, of Simpson County, to erect a telephone system here.

SENATOBIA, MISS.—The municipal electric light and water works will add some street lights to its circuits. F. G. Godfrey is superintendent.

BROOKHAVEN, MISS.—The Brookhaven Light & Water Works expects to double its capacity soon and to change from 125 to 60 cycles. R. S. Purser is superintendent.

SARDIS, MISS.—The Board of Mayor and Aldermen on March 7 awarded to the Panola Electric Light Company the contract for installing a system of street lighting

FORREST, MISS.—At a meeting of the Mayor and Board of Aldermen a franchise was granted to Frank H. Harrison to construct and maintain an electric lighting plant in Forrest, to be in operation before fall.

YAZOO CITY, MISS.—The Board of Aldermen has ordered the Mayor to appoint a committee of three aldermen and citizens to prepare plans and specifications and ascertain the cost of building an electric street railway. The power will be furnished by the city lighting plant.

GRANITE CITY, MO.—The Kinloch Telephone Company has been granted a building permit for the erection of a $7,000 office and exchange building here.

MARYVILLE, MO.—The Council is reported to have under consideration an ordinance providing for the issue of $30,000 bonds for a municipal lighting plant.

FULTON, MO.—The Buffum Telephone Company is to spend $15,000 in improving its service in Fulton. It will put in a new switchboard and new cables all over the city.

KANSAS CITY, MO.—The Metropolitan Street Railway Company has ordered a new 7,500 h.-p. generator, which is to be installed at the Second Street and Grand Avenue power house.

CAPE GIRARDEAU, MO.—M. E. Leming, of this city, is having petitions circulated among property holders asking the City Council to give him a franchise for an electric street railway.

HUNTSVILLE, MO.—The Huntsville Gas & Electric Light Company expects to install an equipment of boiler, engine and dynamo this spring for power service. Chas. W. Hazell is president.

NORBORNE, MO.—The Norborne Fuel, Ice & Light Company has recently changed its name from the Norborne Electric Light & Power Company, and added to the equipment a 4-ton De La Vergne ice plant. F. S. Cunningham is secretary and treasurer.

WELLSVILLE, MO.—The Wellsville electric plant is offering inducements for the location of a factory for the manufacture of any kind of electrical apparatus in its large three-story station building alongside the Wabash tracks at that place. E. F. McBroom is the owner.

BUNCETON, MO.—The electric railway meeting, held March 14, was attended by 200 citizens who reside along the proposed route from Jefferson City to Sedalia, both the terminal points being represented by prominent business men. The road is to be known as the Missouri Interurban Railway Company. An executive committee was named to proceed at once and raise sufficient funds to pay for making the preliminary survey, and to report at the next meeting to be held at California, March 26.

ST. LOUIS, MO.—The St. Louis Electric Terminal Company, better known as the McKinley system, which on March 8 obtained a charter, is the opening wedge which is to spread and give the electric system which is to connect Chicago with St. Louis, an entrance into St. Louis. It is the purpose of the incorporation to establish express and passenger stations at points not far from the river front, and to make the system a competitor for traffic between the two great cities and their connecting links of the middle west. The capital stock is given now at $100,000. Charles Zilly is credited with 900 shares; B. E. Bramble wih 30; W. L. Ferris, 30; George M. Mafts, 30, all of Champaign, Ill., and George L. Edwards, Jay Herndon Smith and Charles W. Moreys, all of St. Louis, one share each.

BUTTE, MONT.—A company, in which Charles R. Leonard, Charles J. Kelly, Harry Gallwey, Henry Mueller, F. Augustus Heinze, Elmer B. Jones and Herbert B. Brown are interested, has asked for a franchise to establish an independent telephone exchange in Butte.

MINDEN, NEB.—This city is to have a new lighting plant.

GENEVA, NEB.—The Fillmore County Telephone Company contemplates many improvements to its system.

HAVELOCK, NEB.—P. T. McGere has petitioned the Council for a franchise for an electric light plant.

GIBBON, NEB.—J. H. Davis & Son have been granted a franchise to install an electric lighting plant at this city.

FREMONT, NEB.—Plans are being discussed for building an electric railway here. E. N. Morse is mentioned as being interested.

GRAND ISLAND, NEB.—At an election $35,000 in bonds were voted for the construction of a lighting plant in connection with the municipal water works plant.

CENTRE HARBOR, N. H.—It is probable that a system of electric lighting for the streets of the town will be established here shortly.

LANCASTER, N. H.—The Lancaster & Jefferson Electric Company is considering extensive changes in its plant. W. U. Colby is superintendent.

NEWMARKET, N. H.—The Newmarket Electric Light, Power & Heat Company is planning to install an additional dynamo in the power house, so that in case of an accident to the present machinery there will be no suspension of service.

HIGHLAND PARK, N. J.—The Borough Council has signed a one-year contract with the Public Service Corporation for lighting the streets of the Borough.

CAMDEN, N. J.—The City Council has adopted the report of the joint committee of Streets and Finance, recommending that legislation be secured looking to the city acquiring municipal ownership of underground conduits.

ORANGE, N. J.—Officers representing Orange, West Orange, East Orange, Bloomfield and Montclair met recently in Orange and discussed plans for establishing a joint municipal electric lighting plant which will furnish light to streets of the different communities and to private consumers in competition with the Public Service Corporation of New Jersey. The combination will appoint a commission under the provisions of a bill now pending before the legislature, will build its own power station and lay its own conduits. The plan has been formulated because of the extortionate rates charged by the local electric lighting concern.

ITHACA, N. Y.—The Ithaca Telephone Company is to lay about 7000 feet of conduit.

WADHAMS MILLS, N. Y.—D. F. Payne has established two water-power plants developing 800 hp.

ELIZABETHTOWN, N. Y.—Mr. C. M. Wood is now manager of the Elizabethtown Electric Light Company.

WELLSBORO, N. Y.—Mr. F. W. Barker is now secretary of the Wellsboro Light, Heat & Power Company.

ELMDALE, N. Y.—The Farmers Telephone Company, with an exchange at Gouverneur is building lines to Elmdale. It will also build lines to Pierce's Corners.

ONEONTA, N. Y.—The Oneonta Light & Power Company will add 180-hp of McCormick-Rodney Hunt wheels to its plant this spring. G. A. Lane is manager and superintendent.

SYRACUSE, N. Y.—The management of the Central New York Telephone & Telegraph Company has been authorized to expend the sum of $200,000 for improvements in the system and service.

GROTON, N. Y.—The village lighting plant will install a separator on one engine and possibly on two the coming summer. Catalogues are requested. M. E. Yates is chief engineer and electrician.

LOCKPORT, N. Y.—The Common Council has granted the petition of the Lockport Gas & Electric Light Company to change the lighting system of the city from the present one to the enclosed-arc lig'ht system.

BUFFALO, N. Y.—A committee has been appointed to investigate the application of the Electrical Transmission Company for a franchise to furnish 60,000 hp of electricity for heating, lighting and power purposes in Buffalo.

MORAVIA, N. Y.—The Moravia Electric Company has recently finished a new station and dam. The station is 25 x 25 ft. equipped with a 1,200-hp McCormick turbine direct-connected to a General Electric alternator. Leslie L. Luther is the engineer.

NEW YORK, N. Y.—Plans have been filed for the enlargement of the power station and car house of the New York City Street Railway Company in the block in Amsterdam Avenue from 128th to 129th Street. The improvements will cost $150,000.

MIDDLETOWN, N. Y.—Superintendent Smith states that the Orange & Rockland Electric Lighting Company has been granted a franchise for lighting the village of Washingtonville. A sub-station is to be built by the company at Chester and that town will also be lighted by electricity.

COOPERSTOWN, N. Y.—At the foreclosure sale in Cooperstown on March 13 the property of the Oneonta, Cooperstown & Richfield Springs Electric Railroad was bid in for $960,000 by Henry W. Bean, chairman of the reorganization committee, subject to $250,000 or more receivers' certificates.

TROY, N. Y.—The bids for lighting the streets and public buildings with electricity and gas, opened on March 16 by the Board of Contract, are stated to have been rejected, being considered too high, and Corporation Counsel Wellington was instructed to draw up a bill to be introduced in the State Legislature, providing for the construction of a municipal lighting plant.

CLYDE, N. Y.—The Village Board of Trustees has made a contract with the Wayne County Electric Company, to run five years from the

first of next June. Under the present contract the village pays $60 per light for fifty lights, but the new contract only provides for forty-five lights, as the village is not allowed to pay for more than the forty-five lamps without a special vote. At the coming village meeting the question of paying for five extra lamps will be voted upon.

HIGH POINT, N. C.—E. J. Justice has been granted a franchise by the board of County Commissioners for the construction of an electric railway from High Point to Greensboro.

STATESVILLE, N. C.—Bids will be received until April 2 by Eugene Morrison, City Clerk and Treasurer, for $20,000 bonds for extending the water and sewerage lines and improving the electric light plant.

SALISBURY, N. C.—The Salisbury Gas & Electric Light Company suffered a severe fire recently. This company has been making numerous extensions and improvements and the loss falls heavily. The whole structure in which the gas machinery was placed was burned out. Simultaneously with the destruction of the plant, began the tearing away for the new structure. The adjoining electric light plant was not hurt.

COURTENAY, N. D.—L. C. Lane will construct a telephone system in this vicinity.

GARRISON, N. D.—The Hughes Electric Company, of Bismarck, N. D., will install a local telephone exchange here.

ANAMOOSE, N. D.—William Bailie, of Valley City, N. D., has been granted a franchise for a local telephone exchange.

FARGO, N. D.—I. H. Richardson, of Minneapolis, manager of the Tri-State Company, is authority for the statement that his company will build a long-distance line into Thief River Falls just as soon as the weather permits.

BURTON, OHIO.—The Burton Electric Light Plant is contemplating the installation of a 50-hp boiler.

NEWTON FALLS, OHIO.—The Newton Falls Telephone Company contemplates further extensions to its system.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) has absorbed the Warrensville Telephone Company and will enlarge the plant.

CANTON, OHIO.—The Street Railway Company has voted to issue $200,000 additional bonds to provide for extensive improvements of the system.

NEWARK, OHIO.—M. L. Gilette, president of the Newark Light & Power Company, states that the company will spend $100,000 for its new power station.

EATON, OHIO.—The Eaton Telephone Company has increased its capital stock from $50,000 to $120,000. It is the intention to make improvements to the system.

CANTON, OHIO.—Property owners of Dalton and East Greenville have petitioned the Canton-Akron Railway Company to extend its West Brookfield spur line to these places.

EAST LIVERPOOL, OHIO.—The North American Manufacturing Company has had plans prepared for the mammoth power house to be erected at Newell, W. Va.

RAGERSVILLE, OHIO.—The Ragersville-Fiat Telephone Company is planning to build new lines to connect with the independent long-distance system at Stone Creek and Yorktown.

CINCINNATI, OHIO.—The water works commissioners have awarded a contract for electric generating equipment for the new pumping station to Dravo, Doyle & Co., of Cincinnati, at $28,692.

OXFORD, OHIO.—The Board of Public Works has made a recommendation to the Council that an appropriation of $5,000 be made at once to install new boilers in the municipal lighting station.

CYGNET, OHIO.—The owners of the local lighting plant have shut off the power in the village because the Council thinks the bills are too large and refuses to pay. The village is contemplating buying a plant.

MEDINA, OHIO.—F. Oatman has sold his interest in the Medina Electric Light Company to local parties for $14,000. The new owners will make important improvements to the plant and the street lighting system.

MASSILLON, OHIO.—The Massillon Light Heat & Power Company has obtained a franchise from the County Commissioners to extend its lines to Canal Fulton and to install a lighting system in that village.

LIMA, OHIO.—Chief Engineer Walker of the Straford Construction Company, a subsidiary company of the Schoepf-Morgan syndicate, has completed four surveys between Lima and Bellefontaine. It is announced that the line will be built this year.

CLEVELAND, OHIO.—The village of Newburg has granted franchises to the Cleveland Electric Railway Company for lines in Kinsman Street, South Woodland Avenue, North Woodland Avenue, Union Street and Rice Avenue. The grants are for twenty years.

TOLEDO, OHIO.—Dr. H. E. Bucklen, of Elkhart, Ind., is negotiating with the Toledo & Western Railway Company to induce it to extend its line from Pioneer, Ohio, to Angola, Ind., to connect with the line which he is promoting between Angola and South Bend.

CLEVELAND, OHIO.—The Cuyahoga County Commissioners are investigating the cost of illuminating the court house and county jail. Gas and electric light bills amount to about $16,000 a year. Estimates for a lighting plant to light the buildings are to be secured.

NILES, OHIO.—The City Electric Light & Water Works proposes to install this summer, a direct-connected 300-kw alternator and a jet condenser. The street lights will be changed from series direct-current to series alternating-current. B. Holoway is superintendent.

SCHOEPF, OHIO.—It is announced that work on the Frey Electric Railway to Wilmington will be started by the middle of April. C. T. Clendenin, president of the New York Construction Company, has been spending several days in this city making arrangements for beginning the work.

CLEVELAND, OHIO.—The Garrett-Cromwell Engineering Company has completed plans for a large open-hearth furnace and bar mill for the Follansbee Bros. Company, Pittsburg, Pa. The plant will be erected at Follansbee, W. Va. A power plant, electric cranes and conveying outfits will be installed.

NORWALK, OHIO.—C. N. Wilcoxson, manager of the Norwalk Gas & Electric Company, states that the company is spending about $15,000 in erecting new mains and street lamps. In the near future all the power will be furnished by the Cleveland & Southwestern Traction Company, to which the lighting company is subsidiary, and the local plant will be changed into a sub-station.

DAYTON, OHIO.—The City Council on March 12 granted a franchise to the Dayton Citizens' Electric Company. Cyrus E. Mead & Co., of Dayton, consulting engineers, writes that the proposed plant contemplated by this company will cost $1,500,000. Valentine Winters is president, and S. W. Davies is secretary.

PAINESVILLE, OHIO.—A company headed by J. R. Curtiss, manager of the Cleveland, Painesville & Ashtabula Railway, is endeavoring to secure a franchise in order to compete with the municipal plant. Power will probably be furnished from the large railway station located on the outskirts of Painesville. Very low rates are offered.

SPRINGFIELD, OHIO.—The Peoples Railway Company, which a short time ago acquired the plant and business of the Springfield Light & Power Company, has completed a large number of improvements to the lighting system. Two large generators have been installed and the street lamps are being replaced with those of the latest type.

COLUMBUS, OHIO.—Announcement was made at the annual meeting of the Columbus Citizens' Telephone Company that the company had perfected a lease of the plants, exchanges and rights of the Franklin Telephone Company. The combined companies have a list of 10,000 subscribers in Franklin County on the city, village and rural lines.

LANCASTER, OHIO.—A syndicate is being formed to take over the Lancaster Telephone Company, which is controlled by the Federal Telephone Company, of Cleveland. The company is making a fine showing and is paying 4 per cent. on $100,000 capital stock. In 1905 the earnings were $20,475, as compared with $17,781 in 1904 and $15,527 in 1903.

ARLINGTON, OHIO.—A new Mutual Telephone Company is being formed in this vicinity. P. J. Baker has been elected president and manager. A number of farmers have joined the mutual agreement, and at the next meeting a committee will be appointed to correspond with supply houses to ascertain the cost of materials and to place contracts.

FOSTORIA, OHIO.—It is announced that the Western Ohio Railway Company interests have decided to build a line from this city to Fremont, Ohio, and that work will commence this spring. This is one of the most important links uncovered in Ohio. The Toledo, Fostoria & Findlay Railway, operating between Fostoria and Findlay, is preparing practically to rebuild this portion.

CINCINNATI, OHIO.—The Cincinnati & Suburban Bell Telephone Company will install a large amount of conduit system. The cost of new conduits will be about $88,000 and the new cables used in them $77,000, making a total expenditure of $165,000, which appropriation has been made by the company. Bids will be called for at once and as soon as the contracts are let the work will be pushed to completion.

TIFFIN, OHIO.—It is stated that Detroit people are negotiating for the purchase of the Electric Railway & Power Company and the Tiffin Edison Electric Illuminating Company. The railway property includes five miles of city lines and a right of way and considerable grading for a line from Tiffin to Fremont. If the deal is consummated, this line will be completed. C. D. Loomis and F. J. Bunn are at the head of the Tiffin companies.

TOLEDO, OHIO.—Toledo people who control the stock of the Toledo, Ann Arbor & Detroit Railway are arranging to refinance the project. It will be remembered that the road became embarrassed through the failure of the Patrick Hirsch Company, which undertook to finance and build it. It is said that about $50,000 has already been invested in the property and the local stockholders hope soon to perfect plans whereby the road can be completed.

CINCINNATI, OHIO.—In his annual report, President James C. Ernst, of the Cincinnati, Newport & Covington Light & Traction Company, announced that the company will spend $175,000 in improvements the coming year. The money will be expended in the installation of a 2500-hp turbine and generator, a new switchboard, 2000 hp. of boilers and auxiliary equipment, largely for the lighting department of the plant. New cars will be purchased and about two miles of extension laid in Newport and vicinity.

COLUMBUS, OHIO.—The Board of Public Service has made overtures to the Columbus Railway & Light Company and to the Public Service Corporation, both of which do lighting in this city to ascertain whether arrangements can be made for supplying the municipal system with power in case the municipal power plant gives out as it did recently.

The board wishes to prevent the possibility of the city's being left in darkness again. New equipment is to be purchased for the municipal plant if an ordinance now pending passes the council.

CAREY, OHIO.—The municipal lighting plant at Carey, Ohio, is said to be proving a success. Six years ago the city was levying five mills annually for the support of the electric light and water works plants and the fund was $600 overdrawn. During the past two years since the municipal plant was improved no levy has been necessary. In the mean time two new boilers, two engines and one dynamo have been installed and paid for, about $800 worth of repairing has been done and $900 paid for new piping, and there is about $1,800 now in the treasury.

CLEVELAND, OHIO.—The Lake Shore Electric Railway has placed orders for four 500-hp Sterling boilers and stokers and to the Wheeler Conder & Engineering Company for a 2000-hp Wheeler condenser. These will be used in connection with the 2000-kw Westinghouse-Parsons turbine ordered a short time ago for the Beach Park power station. A substation equipment will be placed in the station. This additional equipment will give the Lake Shore Electric alternating-current transmission throughout its entire system, the old direct-current generating apparatus at Beach Park being used only for auxiliary purposes.

FINDLAY, OHIO.—The Findlay-Marion Railway & Light Company has increased its capital stock from $25,000 to $250,000. The project has been under way for some time and the company has secured a greater portion of the required right of way from Marion to Findlay by way of upper Sandusky. This is one of several lines which proposes to form a connecting link between Toledo and Columbus. The officers of the company are: R. P. Hankey, of Detroit, president; M. H. Neil, of Columbus, vice-president; G. W. Meeker, of Columbus, secretary, treasurer and manager, and Emmet Tompkins, of Columbus, general counsel. It is stated that work on the Findlay-Marion line will start this summer.

EL RENO, OKLA.—The Canadian Valley Farmers' Telephone Company, in case it cannot effect an arrangement with one or the other of the companies in the city for an interchange of business, will ask for a franchise to construct a line into the city and establish an exchange here.

LAWTON, OKLA.—The Washita Valley Electric Railway Company, which has material on the ground for constructing its line into Chickasha, has applied to the City Council of that place for a franchise granting it the right to construct, maintain and operate an electric light plant.

SEASIDE, ORE.—Rhodes & Welch have secured a franchise tor an electric light plant.

PORTLAND, ORE.—The Portland General Electric Company will extend its lighting system to the Mount Scott district, embracing the settlements along the Mount Scott Railway, when 125 people sign agreements to take the service.

EUGENE, ORE.—F. L. Chambers, of the Chambers Power Company, of Eugene, writes that it is proposed to add to the present power plant a water-driven electric plant of about 100-hp, with plans for three other units of same size.

PENDLETON, ORE.—The Pendleton Water Board has entered into a ten-year contract with the Northwestern Gas & Electric Company to furnish power for the city water works at the rate of $4000 for the first year and $3,500 for each succeeding year. In return for this amount of money the power company agrees to furnish and install a 75-hp motor and a pump capable of pumping 1,200,000 gallons of water a day into the city reservoir. If before the end of the ten years the Water Commission desires to sell the plant, the contract will be void.

NEW CASTLE, PA.—A trolley line is to be erected to connect New Castle and New Wilmington.

BUTLER, PA.—A trolley line is to be constructed from Keister to Slippery Rock, Butler County.

DUNBAR, PA.—The question of establishing a municipal electric light plant is reported to be under consideration.

WILMERDING, PA.—The United Electric Company of this city has decided to increase its capital from $50,000 to $75,000.

LEWISBURG, PA.—The Lewisburg Light, Heat & Power Company proposes to change power from steam to gas (American Crossley engines) during the spring.

CONSHOHOCKEN, PA.—The Conshohocken Electric Light & Power Company intends to extend its lines to Harmonville and Plymouth. W. M. Bell is manager and superintendent.

PITTSBURG, PA.—The corporation committee of councils has approved the ordinance granting the Pittsburg Railway Company a franchise for a new line to Highland Park.

WILKESBARRE, PA.—The dam in the Susquehanna River at Nanticoke, owned by the Pennsylvania Railroad, has been sold to the Nanticoke Electric Power Company for $30,000.

POTTSTOWN, PA.—From present indications the projected trolley road from this city to Swamp will be built during the coming summer by the Schuylkill Valley Traction Company.

HAZLETON, PA.—The Mayor has signed the ordinance granting the People's Consumer Company a franchise for an electric light plant. Harry Mohr, of Hazleton, is reported interested.

SOMERSET, PA.—The Somerset Electric Light, Heat & Power Company has decided to erect a large central station here, to supply light and power to all nearby towns. J. M. Bricker is manager.

CONESTOGA, PA.—The Conestoga Telephone & Telegraph Company has elected the following officers: Henry Hertzler, president; Jacob Hearts, superintendent and manager; Stephen Mast, treasurer.

EBENSBURG, PA.—The Ebensburg & Blacklick Electric Railway Company will be incorporated to build an electric railway from Ebensburg to Blacklick. Captain Thomas Davis will be president.

CANONSBURG, PA.—The Pittsburg Railways Company, which is about to begin the work of building a line from this city to Castle Shannon, has purchased another tract of land in the Chartiers Valley.

BEDFORD, PA.—Plans have been completed by the Bedford County Telephone Company for constructing a copper wire circuit to Altoona to connect with the United Telephone & Telegraph Company at that point.

WELLSBORO, PA.—The Wellsboro Electric Company is about to move in a new building equipped with an Erie engine belted to a 60-cycle, 150-kw General Electric rotating field alternator. W. S. Culver is superintendent.

SCRANTON, PA.—One of the most important business transactions that has taken place in Wayne County in some months was the purchase of the Hawley Electric Light Company by V. A. Decker, Fred C. White and Lewis P. Cooke.

SCRANTON, PA.—Application for a charter for a new electric railway between West Pittston and Luzerne Borough has been made by a number of Scranton capitalists. Postmaster E. Ripple and Attorney N. C. Reynolds are among the prominent promoters.

SOMERSET, PA.—The Somerset Electric Heat, Light & Power Company, composed of Charles Fisher, A. W. Knepper and Joseph M. Bricker, held a conference with a number of citizens of Listle, preparatory to building a line from the company's plant in this city to Listle.

PHILADELPHIA, PA.—Bids will be received until April 7 by Mordecai T. Endicott, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing underground electric lighting cables at the Navy Yard, League Island, Pa. Estimated cost, $10,700.

SCRANTON, PA.—A large number of improvements are shortly to be made by the Scranton Railway Company. Among the most important of these will be additions to the power house and car barn, which will double the capacity of each. The equipment will also be increased proportionately.

PITTSBURG, PA.—Application has been renewed at Harrisburg by the Pittsburg Subway Company for a charter to build an underground railroad in the business section of the city. Horace F. Baker, of Pittsburg, is named as president of the subway corporation, which is capitalized at $50,000.

YORK, PA.—The York Haven Water & Power Company is installing five new generators at its big plant at York Haven, which, when completed, will bring the capacity of the plant up to 10,000 hp. The work on the sub-station at Steelton is nearing completion and the company hopes that in a short time the injunctions against extending its lines in that section will be dissolved by the courts, whereupon power will immediately be transmitted into Steelton. Propositions are pending by which the York Haven Company will supply electricity to many of the manufactories at Steelton, as well as to the Pennsylvania Steel Company. At Middletown, where the York Haven people also have a sub-station, all is said to be working smoothly. The car works are being supplied with power from York Haven, and the Raymond Company, the tube works, and other plants will soon be operated with power from the river plant.

SHAMOKIN, PA.—The consolidation of the various companies situated in Tamaqua, Mahanoy City, Mahanoy Plane, Frackville, Shenandoah, Ashland, Girardville, Mt. Carmel and Shamokin is being arranged, it is said. The New York firm, which so successfully consolidated the lighting and street railway companies in St. Louis and other large cities, is planning to capitalize the new company at from $5,000,000 to $7,500,000 and exchange the stock of the new corporation for that of the various companies interested. The companies directly concerned in the deal are the two in Tamaqua, Shenadoah, the two local companies and those in Mahanoy Plane, Frackville, Girardville, Ashland and Mt. Carmel. With these companies will also be made the purchase of the various trolley companies which obtain their power from the electric light plants to be bought in the deal. Following the consolidation of the various companies the stock will either be increased or bonds will be issued and a large plant will be erected in the center of the district covered by the companies. From this plant power will be furnished for lighting the towns in which the companies are located and for running the trolley lines in the entire region.

PROVIDENCE, R. I.—A bill has been introduced in the lower branch of the General Assembly to amend an act to incorporate the New England Shaver Telephone Company, passed July 23, 1891. The proposed act changes the name to the "Home Telephone Company," and allows the capital stock to be increased to $2,500,000 and permits of a bond issue of $1,500,000. This has been referred to the committee on corporations.

CHERAW, S. C.—The Cheraw Electric Light Plant has just finished putting in larger primary lines and a new and larger transformer.

DUE WEST, S. C.—R. S. Galloway is a member of a committee interested in securing an extension of the Anderson-Belton trolley line on to Due West.

CHARLESTON, S. C.—Bids will be received until April 3 at the Bureau Supplies and Accounts, Navy Department, Washington, D. C., to

furnish at the Navy Yard, Charleston, a quantity of naval supplies as follows: Arc lamps, lightning arresters; poles, etc. Applications for proposals should refer to Schedule 420. H. T. B. Harris, Paymaster-General, U. S. N.

FRANKLIN, TENN.—The Harpeth Electric Light & Power Company will soon install an engine of about 125 hp. Milton Lillie is electrician.

MEMPHIS, TENN.—Thos. H. Tutwiler, president of the Memphis Street Railway Company, announces that a large power house is to be erected at a cost of $200,000.

ATHENS, TENN.—The Athens Light & Power Company will this summer build a new concrete boiler and engine house and add a Greenwald-Brown engine and new boiler. T. J. Long is president and general manager.

CHATTANOOGA, TENN.—It is understood that negotiations for the consolidation of the Chattanooga Electric Railway and the Rapid Transit Company of Chattanooga will be consummated in a short time. As soon as the transaction is completed steps will be taken to improve the system and $1,000,000 will be expended for that purpose.

MOULTON, TEX.—Frank Koenig is reported to have secured a franchise for an electric light plant here.

BRYAN, TEX.—Messrs. Grupe and Harold, of College, are in the city with a view to establishing an electric light plant in this city.

GORMAN, TEX.—The City Council has granted W. A. Waldrop and F. B. Winters a franchise for water works and an electric light plant.

EL CAMPO, TEX.—The Town Council has granted E. Correll, W. J. Hefner and others a franchise for water works, an electric light plant and ice factory.

DALLAS, TEX.—The Southwestern Telephone & Telegraph Company proposes to build five miles of underground conduit for its wires at an estimated cost of $150,000.

WICHITA FALLS, TEX.—The Wichita Falls Water & Light Company intends to install meter all over town in April and start a day circuit this summer. G. S. Landman is electrician.

MINERAL WELLS, TEX.—The City Council has granted a franchise for a street railway and lighting plant to J. D. Beardsley and associates. Mr. Beardsley's associates are J. L. Bradford, of Shreveport, La., and Frank L. Deal, of Mineral Wells.

AUSTIN, TEX.—The Austin Electric Company has begun taking levels from the Federal Building to a point one mile and a half from the Colorado River bridge straight down South Congress Avenue, preparatory to extending the present straight railway into South Austin.

HOUSTON, TEX.—A newly-incorporated company proposes to build a line from Kansas City to a point at Matagordo Bay on the Gulf of Mexico, and a branch line from the junction near Fort Worth via Waxahachie and Corsicana, and a direct line to this city and Galveston. The capital is $10,000,000.

GREEN RIVER, UTAH.—E. T. Merritt is reported to be interested in the construction of an electric light plant here.

HUNTINGTON, UTAH.—The Electric Light & Milling Company, of which O. J. Harmon is president, is reported to have petitioned for a franchise for a lighting plant.

OGDEN, UTAH.—Bids will be received until March 27 by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for conduit and electric wiring system in the post office and court house at Ogden.

OGDEN, UTAH.—The executive committee of the Ogden Rapid Transit Company has decided to build five miles of extension during the present year, and will, in addition, electrify the line from Five Points to Hot Springs. The extension of the line to Bingham City also has been discussed.

SALT LAKE CITY, UTAH.—Bids will be received until May 2 at the office of the U. S. Reclamation Service, Salt Lake City, Utah, for installing in connection with the Strawberry Valley Reclamation project, a telephone system having four telephone stations and about 35 miles of pole line. Geo. L. Swendsen, Engr., Salt Lake City.

OGDEN, UTAH.—The Ogden Rapid Transit Company has made application to the City Council for a new franchise for a term of 50 years, similar to the one it has now. The present power house owned by the company will be enlarged and more machinery installed. These improvements will mean an expenditure of from $150,000 to $200,000.

AMERICAN FORK, UTAH.—The Utah Light & Power Company has decided upon the construction of two plants instead of the one as originally considered. One, a steam plant of 200 hp, will be located here in the town, and a water power plant located in American Fork Canyon, one and a half miles above the other plant. John H. Wootton is manager.

SALT LAKE CITY, UTAH.—T. S. Manley and L. H. Curtis, of Salt Lake City, have asked for a franchise for 50 years to use the streets and alleys of the city for the purpose of building and maintaining an electric lighting, power and heating system. The company will be known as the Salt Lake Public Service Company, with a capitalization of $1,000,000. The financing of the project has already been provided for by W. H. Schott, of Chicago.

SOUTH RYEGATE, VT.—It is reported that an electric light plant will be established here, but none of the details have been given out as yet.

BELLOWS FALLS, VT.—The Fall Mountain Electric Light & Power Company, of which J. B. Crandon, of Bellows Falls, is chief engineer, has purchased a mill site at Gageville, and will probably construct a dam and power station there. Wm. A. Russell, of Boston, is president.

BRADFORD, VT.—The Bradford Electric Lighting Company began to operate its new station and to run the entire 24 hours, February 1. This company lights the villages of Bradford and Newbury. There ought to be a good field for motors to pump water in private houses, there being no water system in the village. B. W. Hutchins is manager.

VIRGINIA BEACH, VA.—The Virginia Beach Development Company, of which A. R. Law is president, is reported to be considering the construction of water works, a sewerage system and electric light plant.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company is installing two new units, an alternator of 300-kw and a direct-current machine of 450-kw at its Roanoke plant, and will install two 500-kw units at Lynchburg. R. D. Apperson is president and manager.

NORFOLK, VA.—The Norfolk Railway & Light Company has just authorized the Southern Contracting Company to put down 180,000 feet of additional conduit, adding a third district to the two on which the company is at work now. The additional conduit makes 600,000 running feet for its extensive underground wire system in Norfolk. The entire installation will cost upwards of $200,000. With the completion of the third district the entire city, between the water front and Queen Street, and between Church and Granby Streets, will be interwoven with a solid network of conduits. The first district comprises the business section west of City Hall avenue. The second district lies between City Hall Avenue and Freemason Street. The third district will extend from Freemason Street to Queen Street. The Norfolk Railway & Light Company will at once remove all of its trolley poles in the fire district and will substitute for them ornamental iron poles, which will carry brackets for arc lights. The new poles will require an outlay of something like $50,000. It was stated several weeks ago that the Norfolk Railway & Light Company contemplated improvements involving an outlay of between $1,000,000 and $1,500,000. The conduit system and improved pole equipment are the first steps in the direction of the proposed improvements, the principal feature of which will be a new power house.

CENTRALIA, WASH.—The Centralia Electric Power Company is reported to have decided to install new dynamos.

EVERETT, WASH.—The Farmers' Mutual Independent Telephone Company will erect a $20,000 brick building.

SEATTLE, WASH.—The Independent Telephone Company will build an exchange building in West Seattle at a cost of $10,000.

PASCO, WASH.—C. A. Cochran, of Kennewick, is reported to have secured a franchise for water works and an electric light plant.

TACOMA, WASH.—We are informed that the Tacoma Gas & Electric Light Company proposes expending $65,000 for general extensions and improvements.

SPOKANE, WASH.—Plans for burying all high-voltage power lines in the city are being made by the Washington Water Power Company. The lines carry a pressure of 60,000 volts.

GOLDENDALE, WASH.—The White Salmon, Trout Lake & Glenwood Telegraph & Telephone Company has applied for a franchise to erect and maintain a telephone system in Klickitat County.

GOLDENDALE, WASH.—The Klickitat Valley Light & Power Company has a transmission line 10 miles long, 6600 volts, stepping down from line transformers to 220/100. H. W. Fellows is owner.

SEATTLE, WASH.—The citizens have voted to issue $600,000 bonds for extending the present municipal electric light plant. As soon as the bonds are sold the work of extending the system will commence.

OLYMPIA, WASH.—Articles of incorporation have been filed for the New World Electric Company, of Seattle. The capital stock is $3,000,000 and the incorporators are: G. L. Tanzer, N. L. Smith and W. R. Williams.

SPOKANE, WASH.—Jay P. Graves is reported to have purchased the franchise and water right held by the Spokane Light & Power Company, and it is stated that an electric light and power plant will soon be constructed.

NEWPORT, WASH.—The plant of the Newport Electric Company, at Bonners Ferry, Idaho, has been in successful operation for several months. It is intended to change from steam to water power in the near future, in which case a 5-mile transmission line will have to be built. J. F. Reynand is superintendent.

KETTLE FALLS, WASH.—Jay P. Graves, of Spokane, of the Inland Empire Electric Railway, is reported to have purchased the falls of Columbia River at Kettle Falls, and will construct an electric generating plant to supply this railway, and also the mines and smelters in the boundary district of British Columbia.

EVERETT, WASH.—The Seattle-Tacoma Power Company has entered upon its three-year contract to light the streets of Everett. The temporary plant in the old nail works building on the water front will furnish the power until such time as the Snoqualmie line is completed to this city, which will be a month or six weeks yet.

GOLDENDALE, WASH.—The parties who recently put in operation the electric light plant on the Klickatat River, seven miles from here, are planning to extend their line to Centerville for the purpose of supplying that town with electricity for lighting and power purposes. The service may also be extended to other towns in that vicinity. J. H. Tilsley, of Spokane; H. W. Fellows, of Goldendale, and Frank Lehr, of Crescent, are interested.

WALLA WALLA, WASH.—Manager J. E. McGilvery, of the Pacific States Telephone Company, who recently came here from Lewiston to take charge, is getting things in readiness for the installation of the new central energy plant. The business here has long since outgrown the present facilities, and in order to take care of the present demand and provide for growth, the new system and a larger switchboard will be installed as soon as the material can be procured. When this is done, the management expects to take on about 500 new subscribers. This will necessitate the construction of about four miles of cable line and three miles of pole line.

CHARLESTON, W. VA.—The Kanawha Valley Telephone Company will petition the council for a franchise to extend its lines on certain streets of the city.

WHEELING, W. VA.—The Wheeling Traction Company has closed two deals for property that gives it a clear right of way from Martins Ferry to Rayland for the new line.

MARTINSBURG, W. VA.—Application has been made by S. W. Walker and J. F. Thompson, representing a syndicate of capitalists, for a franchise for a street railway in this city.

NEW LONDON, WIS.—The New London municipal plant expects to obtain the consent of the City Council this summer to install a 60-kw alternator and high-speed engine.

SHAWANO, WIS.—The City Water & Electric Light Plant expects to change its street lighting system this spring from direct to alternating current. Chas. McCarter is superintendent.

RACINE, WIS.—The Chicago & Milwaukee Electric Railway Company will ask for a franchise into this city. The company's main line runs through the county some distance from Racine.

RACINE, WIS.—The Town Board of Caledonia has granted the application of Manager John I. Beggs, of the Milwaukee Electric Railway & Light Company, for an additional franchise through that township.

VIOLA, WIS.—The Union Telephone Exchange at Viola has been sold to the La Crosse Interurban Telephone Company. The La Crosse Company is to rebuild the exchange and put in a complete new system.

WATERTOWN, WIS.—By a vote of ten to one the special committee of the City Council decided to grant J. I. Beggs, president of the Milwaukee Electric Railway Company, a franchise for a term of fifty years to operate an interurban electric road in and through this city.

MILWAUKEE, WIS.—An underground cable between Milwaukee and Chicago to accommodate all the toll line business between these two points and costing $1,000,000, is one of the projects in the line of improvements contemplated by the Wisconsin Telephone Company for the coming year. Work on the new underground line will be started this summer and it is expected that by January 1 the cable will be ready for use.

MARINETTE, WIS.—The construction of the farmers' telephone line on the Hall Avenue road, according to Manager Bornheimer, will start in the spring as soon as the frost is out of the ground. There is a big demand for the service among the farmers on that road. The line will be extended from the city limits out about four miles, and later will be further extended. A large amount of new cable is to be strung in the city and many of the telephone leads are to be changed to the alleys. Hereafter lines will be put through alleys wherever possible. Thousands of dollars will be spent in the improvement work.

WHEATLAND, WYO.—M. N. Boggs will ask for a franchise to furnish this city with electric lights and pump the city water.

ENDERBY, B. C.—The Hinton Electric Light & Power Company, Victoria, B. C., is negotiating with the town to install an electric light and power plant. Address W. and H. Fraser.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has been solicited by the people of Port Moody and those between that town and the city of New Westminster to build a line between Port Moody and Sapperton.

NEW WESTMINSTER, B. C.—The Canadian Pacific Railway Company has obtained control of the majority of the shares of the Fraser Electric Tramway projected between Chilliwack and New Westminster, and plans to build the line this summer.

ROSTHERN, CAN.—The Town Council is considering rough plans for an electric light and power plant. Address John Hamm.

FARNHAM, P. Q., CAN.—The Farnham Electric Company, during the coming summer, will thoroughly overhaul its plant. W. C. Girard is manager and chief electrician.

CARBERRY, MAN., CAN.—Robert A. Garland, city clerk, writes that the citizens have voted to construct an electric light plant. No engineer has been selected as yet.

PARRY SOUND, ONT., CAN.—The municipal plant is about to install a 425-kw, three-phase, 60-cycle, 2000-volt alternator, an exciter switchboard and a pair of turbines to develop 750 hp under 25-ft. head. G. Croves is electrical superintendent.

BLIND RIVER, ONT., CAN.—The Blind River Light, Heat & Power Company, Ltd., has recently acquired the interest of Lowe & Gray at Blind River, including the electric lighting plant and water works. The former had been built as a competing plant.

OWEN SOUND, CAN.—The Electric Light Department intends to increase the lighting plant from 300 to 800 hp by the addition of a compound condensing Corliss engine, direct-connected to a revolving field generator. J. McLinden is superintendent and chief engineer.

REGINA, SASK., CAN.—The Municipal Electric Lighting Plant has been in operation a year. Its equipment consists of a 300-kw Westinghouse three-phase, 60-cycle machine generating set, 2200 volts, direct connected to an Inglis-Corliss engine running at 150 r.p.m. E. W. Bull is manager.

WINNIPEG, MAN.—The shareholders of the Winnipeg, Selkirk & Lake Winnipeg Railway have transferred the road to the Winnipeg Street Railway Company. A new board of directors was elected, which were virtually those in control of the Winnipeg Street Railway Company.

KENTVILLE, N. S.—The Kentville Light & Power Company, Ltd., expects to change from alternating to direct-current soon. C. L. Baird is superintendent.

FORT WILLIAM, ONT.—The rate payers have passed a by-law to provide $12,000 for improvements to the municipal telephone system. Address Mayor Whalen.

GODERICH, ONT.—J. L. Goldthorpe, of the Maitland River Power Company, writes that bids will be received about June 1 for the construction of a power plant on Maitland River, to cost about $250,000.

BRANTWOOD, ONT.—At the meeting of the fire and light committee it was decided to recommend to the Council that the request of the A. X. Lyons Company for a franchise to supply electric lighting in the mercantile portions of the city should be granted.

TORONTO, ONT.—D. O. Cameron, solicitor of Toronto, is making application to the Ontario Legislature for an act to incorporate the company with power to construct, maintain and operate an electric railway from some point in or near the village of East Toronto, in the county of York, to Yonge Street, Toronto, a distance of 40 miles.

TORONTO, ONT.—W. C. Chilsholm, city solicitor of Toronto, is making application to the Ontario Legislature for an act to enable the city to construct electric railway lines upon independent routes within the limits of the city for the use of the Radial Electric Railways, and to empower the city to make agreements with any electric railway company for the use of the said lines.

HAMILTON, ONT.—The Toronto & Hamilton Railway has given notice that application will be made to Parliament for an act changing the name of the company to the Toronto, Niagara & Western Railway Company, authorizing the company to extend its line from some point on the main line to the International boundary at or near the City of Windsor, increasing the capital stock of the company and authorizing it to enter into arrangements with power companies for the transmission of electric power over its right of way for the purpose of electrifying the road.

TORONTO, ONT.—Controller S. Alfred Jones offered a resolution at the civic reception and legislation committee, calling upon the Ontario Government to establish a power development plant at Niagara Falls in competition with the existing companies. The resolution urged the necessity of the Government themselves at once proceeding to establish a plant at Niagara Falls for the purpose of development of electric power for distribution to Ontario municipalities, and further, that the co-operation of other Ontario municipalities in the matter be requested. The committee voted unanimously to send the resolution on to council.

KINGSTON, ONT.—Sixty thousand dollars will be expended between now and the first of June by the Central New York Telephone & Telegraph Company in extending the scope and increasing the efficiency of its service in the Thousand Island territory and between St. Lawrence River points in general. One of the new cables will connect Cape Vincent with Kingston, via Wolfe Island, and the other will extend from Massena Point to Cornwall on the Canadian shore. The short cable service between Thousand Island Park, Frontenac and the adjacent shore points of Clayton and Alexandria Bay will be made more efficient.

MONTREAL, QUE.—Senator Domville, of St. John, N. B., is said to have secured the aid of a powerful English syndicate for the construction of an electric railway from Montreal to Ottawa and the Great Lakes.

Company Elections.

COLUMBUS, IND.—The Columbus & Seymour Traction Company has elected the following officers: Frank P. Smith, president; Robert O. Beyer, vice-president; Ira E. Gutherie, secretary; H. P. Hughes, treasurer. The company is building a line from Columbus to Seymour to be taken over by the Indianapolis, Columbus & Southern as soon as completed.

DANVERS, MASS.—The Boston Incandescent Lamp Company, of Danvers, at its annual meeting elected the following officers: C. E. Pierce, president; M. M. Merritt, secretary and treasurer, and these with O. E. Jackson are directors.

WARE, MASS.—The Ware Electric Light Company, at its annual meeting, re-elected the directors as follows: Andrew Bryson, Charles C. Hitchcock, Henry K. Hyde, Edward H. Gilbert and Frank M. Sibley. Dr. G. M. C. Barnard was again chosen as clerk and treasurer and William C. Eaton as auditor. F. M. Sibley has been chosen president, and Andrew Bryson and Frank K. Southworth as vice-presidents.

SOUTH HAVEN, MICH.—The Kibbie Telephone Company held its annual meeting in this city and the following named officers were elected: President, S. M. Trowbridge; vice-president, Robert Adkin; secretary-treasurer and general manager, John H. Tripp; assistant general manager, Mrs. J. H. Tripp.

SAGINAW, MICH.—The Bartlett Illuminating Company and the Saginaw Valley Traction Company held their annual meetings in this city, but no change of importance in either directors or officers were made with the exception of Edwin S. Wolff, director and vice-president, succeeding B. C. Cobb. The Bartlett Illuminating Company directors were chosen as follows: George B. Morley, H. T. Wickes, Otto Schupp, H. D. Walbridge, S. E. Wolff. Officers: President, H. D. Walbridge, New York; vice-preption Wolff; secretary-treasurer, Chas. E. Mershon; assistant secretary-treasurer, George E. Hardy, New York. The directorate of the Traction Company includes the following: George B. Borley, Thomas A. Harvey, G. M. Stark, W. T. Wickes; C. M. Clark, of Philadelphia; H. D. Walbridge, of New York; S. E. Wolff. Officers: President, H. D. Walbridge; vice-president, S. E. Wolff; secretary-treasurer, Charles E. Mershon; assistant secretary-treasurer, George E. Hardy.

HUMBOLDT, NEB.—The Speiser Rural Telephone Company has elected the following board of directors and officers: C. Lionberger, president; R. F. Conrad, secretary; Simon Huffman, J. C. Luiginbill, Ed Uhri, Arnold Shuetz, John R. Hunzeker.

HOLDREDGE, NEB.—The Scandinavian Telephone Company has elected the following officers: Ben McArthur, president; Owen B. Wingerd, vice-president; L. P. Christenson, secretary; Walter O. Hopkins, treasurer; Hess, McArthur, Wm. Christenson, trustees.

CLINTON, N. Y.—The board of directors of the Clinton Home Telephone Company have elected the following officers: President, G. J. Caldwell, Clinton; vice-president, George R. Fuller, Rochester; treasurer, Charles H. Poole, Utica; secretary, G. A. Jackson, Utica; engineer, D. A. Cline, Utica.

TOLEDO, OHIO.—At the annual meeting of the Toledo Home Telephone Company the present officers were re-elected as follows: James S. Brailey, Jr., president; R. E. Hamblin, vice-president and secretary; Thomas H. Walbridge, treasurer. The annual report of President Brailey showed that 2,000 telephones were installed the past year.

NEWTOWN, PA.—The Newtown Electric Light Company held its annual meeting and elected the following directors: A. W. Watson, George C. Worstall, T. S. Kenderdine, William M. Watson, George C. Blackfan, Robert Kenderdine, Edward H. Cuckman. The following officers to serve the ensuing year are: A. W. Watson, president; T. S. Kenderdine, vice-president; William M. Watson, secretary; Robert Kenderdine, treasurer.

WESTERLY, R. I.—The following officers were elected at Westerly at the adjourned annual meeting of the Westerly Railway & Lighting Company: President, F. P. Sheldon; first vice-president, G. W. Mansfield; second vice-president, James O. Sweet; secretary, N. B. Lewis; treasurer, Harry B. Ivers; counsellor, Judge N. B. Lewis.

OAKFIELD, WIS.—The Oakfield Telephone Company has elected the following officers: President, A. J. Zielke; vice-president, George Day; secretary, W. E. Bristol; treasurer, C. H. Moore; superintendent, T. E. Worthing.

MILWAUKEE, WIS.—Three new directors were elected at the annual meeting of the Wisconsin Telephone Company. They are: Edward A. Uhrig, president of the Milwaukee-Western Field Company; Julius O. Frank, of the Goll & Frank Company, and Oliver C. Fuller, president of the Wisconsin Trust Company. The other members are Alonzo Burt, Ira B. Smith and Henry F. Whitcomb of Milwaukee; John Balch, Philip Dexter, Frederick P. Fish, Winfield S. Hutchinson and Thomas Sherwin of Boston. The list of officers elected at a subsequent meeting follows: President, Alonzo Burt; vice-president, John D. McLeod; treasurer, C. J. Lins; secretary, Charles A. Grant; general manager, E. B. Cottroll; auditor, O. B. Koepke; engineer, C. W. Burkette.

New Industrial Companies.

THE ELECTRIC SUPPLY COMPANY, of Charleston, S. C., has been incorporated with a capital of $10,000.

THE EVANS PHONOGRAPH RECORD COMPANY, of Jersey City, N. J., has been incorporated by James M. Evans, Jarvis C. Buxton and Charles A. Rainers.

THE ELECTRIC NOVELTY COMPANY, of Memphis, Tenn., capitalized at $10,000, has been chartered by C. T. Kelley, J. J. Peters, G. Benham, F. E. Beardman and S. Mosby.

THE ELECTRO METAL RECOVERY COMPANY, of Jersey City, N. J., has filed articles of incorporation, showing a capital stock of $100,000. The incorporators are John L. De Saulles, George F. Norton and George M. Clarke.

COLUMBIA ELECTRIC METER COMPANY, of Chicago, Ill., has been incorporated, with a capital of $50,000. The incorporators are L. W. Noveander, John Stahr and George F. Higham. The company will manufacture electrical supplies.

H. AND M. AUTOMATIC REGULATOR COMPANY, of Rochester, N. Y., has filed articles of incorporation, having a capital stock of $50,000. The directors are Willard Wadsworth, of New York, and J. M. Taylor and G. E. Taylor, of Rochester.

RECTOR LIGHT SUPPLY COMPANY, of Jersey City, N. J.. has filed articles of incorporation. The company is capitalized at $25,000 and will manufacture gas and electric lamps. C. H. Opdyke, L. A. Opdyke and D. M. Collins are the incorporators.

THE U. S. ELECTRIC PORCELAIN COMPANY, of Findlay, Ohio, has been incorporated with $25,000 capital stock. The incorporators are J. S. Milligan, C. E. Wilhar, J. K. Henry, R. H. Sharp and C. E. Myers. The company will manufacture porcelain insulators and electrical specialties.

ASSOCIATED GAS & ELECTRIC COMPANY, of Penn Yan, N. Y., has been incorporated and will engage in the manufacture of engines, boilers and dynamos. The company has a capital of $1,500,000, and E. M. Treman, T. W. Summers and D. D. Norton are named as directors.

THE OVINGTON MANUFACTURING COMPANY has been organized in Portland, Me., for the purpose of manufacturing and dealing in electrical therapeutic apparatus, motors, dynamos, etc. The company's capital stock is placed at $250,000, and the officers are: Millard W. Baldwin, president; Clarence E. Eaton, treasurer, both of Portland.

THE DE FORD AUTOMATIC SWITCH COMPANY, of Logansport, Ind., has filed articles for incorporation with the Secretary of State. The company proposes to establish a plant to manufacture automatic switches and devices for steam and electric railroads. The incorporators are Joseph H. De Ford, Joseph C. Heyworth, William H. Porter and W. D. Pittman.

New Incorporations.

LOS ANGELES, CAL.—Articles of incorporation of the Los Angeles & San Diego Beach Electric Railway Company have been filed with the County Clerk. The company is capitalized at $6,000,000 and the following directors have been elected for the ensuing year: E. S. Babcock, A. E. Babcock, R. B. Talbot, A. E. Lillicrap and James Strout.

RINARD, ILL.—The People's Telephone Company of Southern Illinois has been incorporated, with a capital of $10,000.

FLORA, ILL.—The Flora Telephone Company has been incorporated with a capital stock of $20,000. The incorporators are: E. G. Myers, J. B. McFarland and W. A. Karr.

ELGIN, ILL.—Incorporation papers for the Elgin & Du Page Electric Railroad Company, which will spend $700,000 in building a line from River Forest to this city, have been filed with the Secretary of State.

ROCK GROVE, ILL.—The Rock Grove Farmers Mutual Telephone Company was incorporated recently with a capital stock of $6,000. The incorporators are: Lewis E. Rote, William Fisher and Martin Brobst.

CENTRALIA, ILL.—The Secretary of State has issued a license to incorporate the Ohio & Mississippi Electric Railway Company, with a capital stock of $5000, the incorporators being C. D. Tutts, F. P. Pullen and John J. Bundy.

LOCKMAN, IND.—The South Side Telephone Company, with a capital stock of $2000, has been incorporated by James C. McKinney, Charles W. Spurgeon and others.

BROOK, IND.—The Newton-Jasper County Telephone Company has been incorporated with a capital stock of $7,500. John A. Sell, T. L. Davis and J. W. Saye are the directors.

FORMOSA, KAN.—The Formosa Mutual Telephone Company has been incorporated with a capital stock of $7500.

STANFORD, KY.—The Interstate Traction Company has been organized with W. G. Schanberger president. The company has a capital of $130,000.

ADAIRVILLE, KY.—A new corporation to be known as the Red River Telephone Company has been organized by T. H. Baird and others, and proposes to operate under the franchise recently sold to W. K. Smith.

LOUISVILLE, KY.—The General Telephone Company has been organized to take over the Independent Long Distance and all smaller companies in Owensboro, Lexington, Maysville, Paris, Eminence and other points.

PEMBROKE, ME.—The Pembroke Power Company has been organized for the purpose of generating gas and electricity for heating, lighting and power purposes in the towns of Pembroke and Perry in Washington County, with $50,000 capital stock, of which $300 is paid in. Officers: President, H. L. Cram, of Portland; treasurer, A. F. Pine, of Portland.

UNADILLA, NEB.—The Unadilla Telephone Company, an independent company organized at Unadilla, Otoe County, has filed articles of incorporation with the Secretary of State. The company has a capital stock of $30,000. The incorporators include many of the farmers residing in the vicinity of Unadilla.

ATLANTIC CITY, N. J.—The Atlantic City Light & Equipment Company has been incorporated, with a capital stock of $50,000, by James J. Farmer, Harry R. Harris and G. B. Clemmer.

JERSEY CITY, N. J.—The American Wave Power Company has filed articles of incorporation and is capitalized at $100,000. Greenville Stevens, Timothy Walsh and A. A. Kelley are the incorporators. The company will utilize the power of water waves in the generation of electricity.

JERSEY CITY, N. J.—The Guatemala Tramway, Light & Power Company has been incorporated at Jersey City for the purpose of establishing plants, etc., in Guatemala. The capital is $4,000,000, and the incorporators R. D. Chipp, K. K. McLaren, H. S. Gould, Jersey City.

TAOS, N. M.—The Taos Valley Telephone Company, with headquarters at Taos, has been incorporated with a capital stock of $5,000. The incorporated by S. M. Stevens and others of Tedrow. Dorney, Juan A. Vigil and others.

STERLING STATION, N. Y.—Red Creek & Fair Haven Telephone Company has been incorporated, with a capital of $930, by W. Bailey, N. Cuyler and V. Hersey.

HUNTS CORNERS, N. Y.—The Lapeer Telephone Company has been organized with the following officers: President, Lester Parker; vice-president, Wallace B. Lusk; secretary, E. E. Hults; treasurer, W. R. Pease.

NORWAY, N. Y.—The Crockett Ridge and Millettville Telephone Company has been incorporated with a capital stock of $5,000. President, E. B. Tubbs; treasurer, H. G. Dinsmore; clerk, A. T. Crooker, all of Norway.

EAST SPRINGFIELD, N. Y.—The East Springfield Telephone Company has been incorporated by Henry Rathbun, of Cooperstown; S. A. Young, H. W. Young and O. R. Young, of East Springfield. The company has a capital stock of $10,000.

EVANS MILLS, N. Y.—The North County Telephone & Telegraph Company has been incorporated with a capital stock of $15,000. The directors are: F. E. Rosbrook, M. J. Matty, C. E. Pail, Stephen Gould, F. G. Rosbrook and E. E. Ward, of Evans Mills, and A. I. Rosbrook, of Carthage.

PINGREE, N. D.—The Pingree Telephone Company, having a capital of $50,000, has been incorporated by James Price, Thomas Price, Oscar Boyd, O. H. Dahl, H. M. Dahl, of Pingree.

TEDROW, OHIO.—The Tedrow Telephone Company has been incorporated by S. M. Stevens and others of Tedrow.

CANON CITY, OHIO.—Organization of the Canon City, Florence & Royal Gorge Interurban Railroad Company has been effected here with a capital of $1,500,000.

CLEVELAND, OHIO.—The Lake Erie Terminal Southern Railway Company has been incorporated with $125,000 capital stock, by H. B. Camp, of Akron; R. J. Wood, Fred W. Green, J. R. Zunt and H. McIntyre, of Cleveland. The company proposes to build a line of railway from Cleveland to Akron and Massillon down the Cuyahoga River.

NEW LEXINGTON, OHIO.—The Citizens' Independent Telephone Company was recently incorporated with a capital stock of $50,000. The following are the officers: W. L. Cary, Jr., president; S. M. Granger, vice-president; T. J. Smith, secretary and general manager; J. B. Rhodes, treasurer. Arrangements are to be made immediately for establishing at New Lexington a modern telephone exchange which will be capable of serving the whole of Perry County. The many towns and rural districts will be connected with the New Lexington exchange.

CINCINNATI, OHIO.—The Cincinnati Light, Heat & Power Company has been incorporated with $100,000 capital stock by Guy Mallon, H. J. Bechtel, E. R. Stearns, C. W. Cole, of Cincinnati, and Cyrus E. Meade, of Dayton. The company proposes to apply for a franchise for supplying electricity for commercial purposes in Cincinnati. According to a statement made by Mr. Mallon, the capital stipulated is merely nominal and it will be increased from $6,000,000 to $8,000,000, when a franchise is secured. The company will offer to supply current for light and power purposes at a maximum rate of 8 cents per kw-hour. It will offer to pay the city 1 per cent. of the gross receipts. Another feature of the proposed franchise will be a clause agreeing to turn the plant over to the city at the expiration of the 25 years at its value as a physical property. The company is willing to place a large proportion of its mains underground.

HITCHCOCK, S. D.—The Pioneer Telephone Company has been incorporated with $5,000 capital. Chas. McFarland, secretary.

HOT SPRINGS, S. D.—The Sheep Canyon Telephone Company has been incorporated with $5,000 capital to build a line to Oelrichs. C. E. McClelland, secretary.

COLUMBIA, S. C.—The North Columbia Land Company has been organized here, its charter rights including the installation of electric light and sewerage systems.

LADONIA, TEX.—The Ladonia Light & Water Company has been incorporated with a capital of $30,000.

GALVESTON, TEX.—The Galveston Electric Park & Amusement Company has been chartered here with a capital stock of $15,000. The incorporators are Dave A. Weis, Elias Makeowitz and Lewis Fisher, all of Galveston.

GEORGETOWN, TEX.—The Georgetown Water, Light & Power Company has been incorporated with a capital of $100,000, by W. N. Coler, Jr., of Newark, N. J.; C. S. Hole, of Georgetown; Benj. B. Cain, of Tyler, Tex., and others.

OLYMPIA, WASH.—The Olympia Light & Power Company has announced to its patrons that all electricity furnished by it will be placed on a meter basis from May 20. Flat rate service will be discontinued.

PORT TOWNSEND, WASH.—Articles of incorporation have been filed by John Siebenbaum and others looking to the consummation of the plans of the organization for the establishment in the city of an up-to-date electric plant. The name of the corporation is the Citizens' Electric Company, capital $30,000.

Legal.

WATER POWER RIGHTS.—Judge J. W. Hughes has handed down a decision in favor of the State against the Sacramento Electric, Gas & Railway Company, in which he holds that the State has the right to all the water at the first fall in the canal at Folsom Prison, and that the company has no right to place a shutter on the gate at the head of the canal to conserve the water at the dam for its own use. The decision is an important one, and is the outcome of years of litigation.

BOILER LITIGATION.—We are informed by the Babcock & Wilcox Company that a decree has been entered in the case of the Babcock & Wilcox Company against the Aultman & Taylor Machinery Company for infringement of trade-mark, in the United States Circuit Court for the Eastern Division of the Northern District of Ohio, in which the trade-mark of The Babcock & Wilcox Company is sustained as good and valid. It consists of the word "Steam," accompanied by a representation of the type of engine known as the "Aeolipile of Hero," which consists in part of a sphere.

WESTINGHOUSE LEGAL DECISIONS.—We are advised by the Westinghouse Electric & Manufacturing Company that several legal decisions have recently been recorded in its favor. In the United States Circuit Court of Appeals for the Third Judicial Circuit in Philadelphia a decision has been handed down in an appeal from the Circuit Court for the Eastern District of Pennsylvania in the case of the Westinghouse Electric & Manufacturing Company against the Cutter Manufacturing Company. This suit involves the Wright and Aalberg patent on automatic circuit breakers of the edgewise shunt carbon type, in which the shunt carbons are at the top of the device and the movable contacts are carried by a long swinging arm equipped with toggle mechanism for giving it a wide throw in opening the circuit. The Court in its decision enjoined the Cutter Company from the manufacture of circuit breakers which come within the claims of the Wright and Aalberg patent. In the United States Circuit Court for the Southern District of Ohio, sitting at Cincinnati, the case of the General Electric Company against the Bullock Electric Manufacturing Company was decided in favor of the former. This suit involved the Reist patent on armatures for dynamo-electric machines ventilated by having certain forms of space-blocks inserted between the different groups of laminæ forming the core or magnetic circuit of said armatures. Judge Thompson held that two forms of ventilators being involved in this suit were infringements. In the case of the Westinghouse Electric & Manufacturing Company against the Diamond Meter Company, of Chicago, an interlocutory decree has been filed by Judge Humphrey in the United States Circuit Court for the Southern District of Illinois, sitting at Peoria. In this decree the Diamond Meter Company is permanently enjoined from manufacturing, using or selling induction wattmeters under the Tesla patents Nos. 511559 and 511560.

Obituary.

MR. JAMES PARTRIDGE.—Announcement is made of the death of Mr. James Partridge, manager of the Sandusky, Ohio, plant of the National Carbon Company. Mr. Partridge was born in Birmingham, England, in 1854. With Mr. John Spear he organized and conducted the Partridge Carbon Company in Sandusky, which concern was purchased by the National Carbon Company in 1899. He was retained by the National Carbon Company as manager of the Sandusky works. Deceased is survived by his wife and two sisters. He was well and widely known in the electric lighting field.

Educational.

OKLAHOMA COLLEGE.—Morrill Hall, Oklahoma Agricultural & Mechanical College, Stillwater, Oklahoma, is to be equipped throughout with a fan blower system, utilizing the fans, motor, heater and tempering coil built by the B. F. Sturtevant Co., of Boston, Mass. The blacksmith shop of the same college is also to be fitted with a complete equipment of forges from the same source.

Personal.

MR. C. H. JUDSON has recently taken charge of the engineering work of the Seattle (Wash.) Independent Telephone Company as chief engineer.

MR. RALPH D. MERSHON, consulting electrical engineer, has removed his New York offices to 60 Wall Street. His Montreal office is in the Street Railway Chambers.

MR. LOUIS J. MAGEE, resident director in this country for the Allgemeine Elektricitaets Gesellschaft, of Germany, has just returned home to New York from a trip of several weeks to Europe.

MR. HAMILTON BALUSS, general manager of the Marquette City & Presque Isle Railway Company, Marquette, Mich., has resigned his position with that company to accept a similar one with the Susquehanna Traction Company, of Lock Haven, Pa.

MR. C. A. COFFIN, president of the General Electric Company, who has been touring in the Mediterranean and in Egypt since the beginning of the year, has just returned home in excellent health, by the "Celtic," having greatly enjoyed the rest and the trip.

MR. CHARLES H. COAR has resigned his position with the Northwestern Telephone Company to accept a position with the Twin City Telephone Company in its engineering department. Mr. Coar was recently appointed a member of the Minnesota State Board of Electrical Examiners by Governor Johnson.

MR. MAX LOEWENTHAL, who for some years has given special attention to electric heating problems, and has developed the heating departments of central station companies, has established himself at 150 Nassau Street, New York City, as a consulting engineer in that new and progressive eld. His unique and extensive experience render his services of great value to any client.

MR. YOSHIO KINOSHITA, delegate of the Imperial Japanese Government to the International Railway Congress held at Washington last May, has since that time been investigating railroad conditions in this country, with special reference to the finances and economics of the electrification of steam systems. He proceeds this week by "Celtic" to England, where he will pursue his studies of the subject for some months.

MR. F. B. HUNTINGTON, vice-president and secretary of the Fond du Lac Street Railway & Light Company, Fond du Lac & Oshkosh Street Railway Company and the Eastern Wisconsin Street Railway & Light Company, has resigned and has gone to Chicago where he has accepted a position as comptroller of the Chicago Terminal & Transfer Company. Mr. Huntington went to Fond du Lac June 1, 1903, accepting a position with the Fond du Lac Street Railway company as secretary. He was there but a short time when he was elected secretary of the Eastern Wisconsin Street Railway & Light Company and soon after he was elected secretary of the Fond du Lac & Oshkosh Railway Company. Upon the death of F. B. Hoskins recently Mr. Huntington was elected secretary and vice-president of all three companies.

MR. F. A. STRATTON, president of the Westchester Lighting Company since its formation, tendered his resignation at the annual meeting of the company held on Tuesday, March 13. At the request of the directors and owners of the property, Mr. Stratton will remain as a director and will probably become chairman of the board of directors, a position heretofore held by H. E. Gawtry, formerly president of the Consolidated Gas Company of New York City. It is not known as yet who will succeed Mr. Stratton, but it is understood that it will be a Westchester County man. The new directors of the company are W. R. Addicks, J. C. Brady, H. E. Gawtry, T. E. Murray, J. W. Sterling, F. A. Stratton, W. W. Scrugham, H. Brown, R. A. Carter, W. F. Hall and I. L. Benedict, and the choice will likely fall on one of them. Mr. Stratton has worked incessantly for nearly seven years in developing the Westchester Lighting Company and its territory, and it is said that his object in declining to accept re-election was to relieve himself of the detail work which has grown to a large extent. As chairman of the board of directors, it is understood that he will have an active part in outlining the policy of the company, which has been of a highly progressive nature. The change will not affect Mr. Stratton's interests in the Northern Westchester Lighting Company of which he is president.

Trade Publications.

CEILING FANS.—The Century Electric Company, 404 North Fourth Street, St. Louis, Mo., has issued an illustrated booklet describing "Pillsbury" alternating-current ceiling fans, and incidentally calling attention to "Century" self-starting single-phase motors.

FAN MOTORS FOR DIRECT CURRENT.—In a welll-prepared bulletin, designated as No. 20, the Peerless Electric Company, Warren, Ohio, deals with direct-current fan motors and with oscillating fans, desk fans, ceiling and column fans driven by these machines.

DIRECT-CURRENT FANS.—Catalogue No. 18, of the Fidelity Electric Company, Lancaster, Pa., gives an interesting discussion on the constructional features of electric fan motors for direct-current circuits. The company has also issued a folder devoted to "Eclipse" sockets fans for both alternating and direct current.

ALTERNATING-CURRENT FANS.—Catalogue No. 4200, of the Emerson Electric Manufacturing Company, St. Louis, Mo., is a neat publication describing in detail fans for alternating current. Much valuable information is given concerning the construction and operation of desk fans, ceiling fans, column fans and exhaust ventilating fans.

DESK FANS.—Bulletin No. 10 of the Colonial Fan and Motor Company, Warren, Ohio, is devoted to direct-current desk and ceiling fan motors. Views are given of swivel desk fans, plain and ornamental ceiling fans, and oscillating fans. The oscillating fan is provided with a shifting vane which causes the body of the fan to rotate on ball bearings.

BATTERY FANS.—The Edison Manufacturing Company, Orange, N. J., is distributing a neat booklet devoted to battery fan motor outfits. These outfits have been designed for service where electric current cannot be obtained directly from a supply system. Thus they can be used in summer homes, yachts, private cars, etc.

FAN MOTORS.—The Western Electric Company, Chicago, Ill., has issued an elaborate publication dealing with desk, bracket and ceiling fans, and a recently developed universal fan which can be changed from the desk to the bracket model without the necessity for a separate part. The motors are built for either direct or alternating current circuits.

VENTILATING APPARATUS.—Bulletin No. 24 of the Jandus Electric Company, Cleveland, Ohio, describes combination desk and bracket fans for alternating and direct current, and gives much information concerning ceiling and column "Groofans" which are claimed to be the best and handsomest of all breeze makers.

News of the Trade.

THE COAL AND IRON NATIONAL BANK, of the City of New York, has been designated a depository of the United States, as well as of the city of New York and State of New York.

THE GARFORD COMPANY, of Cleveland, Ohio, manufacturer of automobile parts, has decided to consolidate its plants at Elyria, Ohio, and will spend $300,000 in improvements. A power plant will be erected and all the machinery will be driven in groups by motors.

THE SYRACUSE SUPPLY CO., Syracuse, N. Y., which is a large dealer in steam fittings, material, supplies, etc., has opened an electrical department and is carrying a full stock of electrical supplies. The department has been placed in charge of Mr. F. S. Baldwin, late of the R. M. Cornwell Company. It is in the market for electrical supplies of all kinds.

THE BENJAMIN ELECTRIC COMPANY, Chicago, started in the basement of a flat building in Chicago about four years ago. Not long afterwards large downtown quarters were obtained. The business soon outgrew these and another change was made to the present quarters at the corner of Jackson Boulevard and Canal Street, Chicago, in the heart of the manufacturing district of that city. At the present time the factory occupies 9,600 square feet of floor space, but by May 1 additional space will be acquired which will give a total of 16,900 square feet.

FOSDICK LATHE.—The Cincinnati Lathe & Tool Company, 2730 Spring Grove Avenue, Cincinnati, has purchased the lathe business of the Fosdick Machine Tool Company, the latter concern making a 16-inch lathe with the T. T. Emmes patent feed device. The plant is situated at the heart of the machine tool district, and will be in running order by April 1. The company is now receiving orders for future delivery. Mr. W. C. Heindel, long in the milling machine trade, is president of the company, and Mr. A. B. Sowden, who has been building lathes for twenty years, is the superintendent, and who proposes to maintain the high reputation already gained.

STEAM TRAPS.—The improved Sturtevant steam traps, although especially designed to use with Sturtevant heaters, is said to be equally well fitted for operation with steam heaters or radiators of any construction. The body of the trap contains a pot, which floats and closes the connection between the interior and exterior, until sufficient water accumulates in this space to overflow into the pot and sink it. Free passage for the water is thus afforded from the pot up to the outer air, which continues until the levity of the pot becomes sufficient to cause it to rise and close the outlet. The periodic delivery continues as long as there is water to discharge or sufficient steam pressure to cause the trap to act.

THE CHICAGO PNEUMATIC TOOL COMPANY has closed its Norfolk, Va., office, and will, in the near future, open an office in Richmond, Va. The office at 602 Empire Building, Pittsburg, Pa., will be closed April 1, and moved to 10 and 12 Wood Street, at which point a store building has been secured for the purpose of making a general display of air compressors, tools, etc., a large stock of which will be carried as soon as the factories are in position to furnish same. An up-to-date repair department will also be maintained at that point for the benefit of the large number of customers in the Pittsburg district. The office has been closed at Seattle, Wash., and a new office opened at No. 64 Sixth Street North, Portland, Oregon. The Company reports business entirely satisfactory both at home and abroad and all factories working double time.

LARGE FAN PROPULSION.—With the advent of electricity as a motive power the adaptability of the electric motor for fan driving led the B. F. Sturtevant Company, of Boston, Mass., to design a special line of motors adapted for direct connection to fans. In the smaller sizes of the cast-iron fans, the substantial side plate furnished a suitable base to which the motor could be attached. But in fans of larger capacity, operating at low rotative speed, motors were designed to be attached to the steel plate and angle construction as to form a most subsantial and easily portable electric fans. The latter type of motor readily adapted itself to use as a generator, to be driven by a direct-connected Sturtevant engine, and the Sturtevant generating set soon became an established feature of the business.

WAGNER ELECTRIC AGENCY CHANGES.—The Wagner Electric Manufacturing Company, St. Louis, Mo., desires to announce that it has recently completed arrangements by which sales of its apparatus in Texas, Indian Territory and Oklahoma will be taken care of by the Woods Electric Company of Houston, Tex., successor to D. F. Woods & Company. The sales department will be under the immediate supervision and management of Mr. William F. Sullivan, who for a number of years has been intimately connected with the Crocker-Wheeler Company, and for the last two years in its St. Louis office. The Wagner Company also announces that its Atlanta territory, which was formerly handled by Mr. G. C. Henry, who has been devoting only a part of his time to Wagner interests, will now he handled exclusively by him.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 13, 1906.
Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

814,669. ELEVATOR BRAKE; John E. Boyce, New York, N. Y. App. filed Jan. 11, 1905. A lever placed similarly to the usual engineer's valve controls various pilot circuits which cut in and out various resistances in circuit with the brake magnet. The same lever also controls additional circuits which make the motor act as a generator to supply current for the brake as the train is coming to rest. In this way the braking pressure is properly reduced as the train speed diminishes.

814,671. SYSTEM OF PREVENTING THE COLLECTION OF ICE ON RAILS. Jeremiah D. Burns, Washington, D. C. App. filed Feb. 7, 1905. In order to prevent an accumulation of ice and sleet on the rails in winter the patentee has hooks on the rail web which serve to hold an insulated resistance wire in contact with the upper part of the rail. The insulating material is of such a nature as not to impede the transfer of heat, for example, concrete.

814,680. TELEPHONE ATTACHMENT; Bernhard Ehrlich, Vienna, Austria Hungary. App. filed May 3, 1905. An attachment for telephones consisting of a rigid body piece and a plurality of leaves placed one upon another and secured to the body piece, said attachment having an opening extending therethrough and a removable plate or slide-carrying netting treated with germicidal substance placed over the opening aforesaid and slidably engaging said body piece.

814,691. STORAGE BATTERY; Howard B. Hallock, Germantown, Pa. App. filed May 15, 1905. In a storage battery, a jar of non-conducting material, two horizontally arranged plates contained within the jar, the lower plate resting upon the bottom of the jar, the lower end of the sides of the jar to a height approximately level with the top of the lower plate being inclined inward and downward, the lower plate consisting of a grid of conducting material, said grid consisting of a frame, inclined to fit upon the inside surface of the inclined sides of the jar and surrounding the plate with ribs extending across from one side to the other, and active material pasted on to the grid, a separator resting upon the top of the lower plate, the other plate resting upon the top of the separator.

814,692. MERCURIAL ALKALINE PROCESS; Willis E. Harmon, Mechanic Falls, Me. App. filed July 6, 1905. In a mercurial alkaline process the insertion of pieces of carbon in the amalgamating compartment in contact with both the mercury and the electrolyte.

814,695. VAPOR ELECTRIC LAMP; Peter C. Hewitt, New York City, N. Y. App. filed July 7, 1904. In a gas or vapor electric apparatus, comprising a container, electrodes therein, at least one of which is mercury, a gas or vapor other than the mercury vapor, and means for condensing approximately all the vapor of mercury developed from said electrode at or near the electrode itself.

814,696. METHOD OF PRODUCING LIGHT; Peter C. Hewitt, New York City, N. Y. App. filed Oct. 19, 1904. The method of producing a predetermined luminous effect by means of a gas or vapor electric apparatus containing as one of its electrodes a conducting liquid capable of being volatilized and condensed under the influence of electric current and also containing a gas or vapor other than the one which is developed from the conducting liquid under current influence, which consists in starting the apparatus by any approved means, and condensing all or a portion of the vapors developed from the described electrode at or near the point of development, thereby permitting current to pass mainly through the said other gas or vapor and developing its characteristic light.

814,726. VACUUM ELECTRIC FURNACE; Henry N. Potter, New Rochelle, N. Y. App. filed July 23, 1903. On an air-tight electric furnace having cool portions, an articulated containing vessel is interposed between the highly-heated furnace interior and an exterior seal or seals.

814,727. ELECTRIC PRESSURE FURNACE; Henry N. Potter, New Rochelle, N. Y. App. filed July 23, 1903. In an electric furnace, an inner conducting-tube, an outer conducting tube surrounding the same, and electrical connections between the ends of the inner tube and the ends of the outer tube, the latter being insulated from each other except through the inner tube.

814,740. ELECTRIC MOTOR; John A. Smith, Dayton, Ky. App. filed Nov. 28, 1904. In order to provide a variable speed motor with constant torque under all conditions, the patentee has in addition to the usual field windings a pair of supplemental bobbins which energize the fields, but do not make a complete magnetic circuit so that the energization is only to a feeble degree. Under these circumstances the speed increases, but sparking is overcome.

814,761. TELEGRAPHIC SAFETY DEVICE; Selden R. Wright, Morton, N. Y. App. filed Oct. 13, 1903. The patentee provides a special circuit completed by the release of an ordinary telegraphic relay which starts a clockwork mechanism into action. If the telegraph circuit is broken for a considerable time the clockwork action rings an alarm circuit and repeats the alarm at hour intervals thereafter.

814,771. ELECTRIC RAIL BOND AND METHOD OF MAKING SAME; Samuel P. Cowardin, Richmond, Va. App. filed Mar. 6, 1903. A bond is formed by clamping the usual copper leaves or ribbons in a suitable mold and pouring fusible metal therein which will solder itself to the ribbons and for the bond terminal.

814,781. FIRE ALARM AND SPRINKLER ATTACHMENT; James Hartley, Philadelphia, Pa. App. filed June 9, 1905. The sprinkler valves are held in place by fusible metal fastenings in the usual way, and complete an electric circuit whenever the valve opens. In addition to this there is another alarm which is actuated preliminary to the operation of the sprinklers, so that a fire alarm may be given, and an opportunity afforded to extinguish it, before the sprinklers afterward operate with their attendant damage.

814,794. METHOD OF PRODUCING VACUUM LAMPS; Dan. M. Moore, Newark, N. J. App. filed Apr. 21, 1904. The herein-described method of manufacturing electrically-operated vacuum tubes, consisting in coating the interior of a tube or receptacle of any desired form adapted for use in the completed device with an organic substance, electrolyzing said substance to form an adherent coating of an electrolytically-produced substance upon the interior of the receptacle or tube and utilizing said tube as a tube or section of tube in the complete device.

814,810. METALLURGICAL PROCESS; Frederick T. Snyder, Oak Park, Ill. App. filed June 23, 1905. The herein-described process of treating sulfid ore, which consists in dissolving the same in a fused-mineral bath, and subjecting the mixture to the action of an electric current in the presence of carbon, at a high temperature, the sulfid being broken down, the metal thereof liberated and carbon bisulfid formed at the same time by the reaction of the sulfid and carbon.

814,814. AMALGAMATING PROCESS; Herbert A. Thomas, Chicago, Ill. App. filed Aug. 22, 1904. The dry amalgamating process herein described consisting in insulating a body of liquid mercury, charging it electrostatically, and feeding through it a thin sheet of pulverized ore, whereby the precious metals are amalgamated or removed from the ore and the mercury completely freed and separated from the tailings, substantially as specified.

814,825. BATTERY ZINC; Horatio J. Brewer, New York City, N. Y. App. filed Aug. 24, 1905. An electrode for electrogalvanic batteries, consisting of a cylindrical rod of zinc formed with an external flat surface for contact with a terminal wire, said contact surface extending longitudinally with relation to the axis of the rod, the rod being also formed with a transverse hole extending through said contact surface, and with a transverse shoulder adapted to engage and support a flat side of a screw nut, and a binding screw engaging said transverse hole and arranged to secure a terminal wire against said contact surface, for the purpose described.

814,830. TELEPHONE SYSTEM; Louis W. Carroll, Anamosa, Iowa. App. filed Mar. 24, 1903. In a telephone system, in combination, a central or exchange station, a metallic circuit leading therefrom and being normally open at said station, a plurality of telephones bridged into the circuit, each telephone having an annunciator and a signaling generator, a normally open grounded connection for each signaling generator, and an annunciator at the central or exchange station located in a grounded connection of one side of the metallic circuit.

804,838. STOP MECHANISM FOR STEAM ENGINES; Joseph E. J. Goodlett, Memphis, Tenn. App. filed Apr. 27, 1905. The governor shaft moves to and from an adjustable contact in normal operation. In case of excessive speed, a circuit is opened which electrically trips a valve and causes the steam pressure to move a piston which is geared to close the throttle.

814,852. ELECTRIC SPRINKLER APPARATUS; Joseph W. Larish, Boston, Mass. App. filed June 4, 1904. In order to provide an alarm in case the usual valves of a sprinkler system becomes leaky, the patentee has spring blades normally separated by tissue paper or soluble gelatine, so that the blades come together and make an electrical circuit in case the tissue paper or gelatine is dissolved by the leakage.

814,864. ELECTROLYTIC APPARATUS; Frank McDonald, Roaring Spring, Pa. App. filed Apr. 27, 1905. In an apparatus of the character described, the combination of an electrolytic-cell, a tank in communication with the anode compartment of said cell, a supply pipe for supplying a solution of brine to said anode compartment, a valve in said supply pipe, a ball float in said tank connected by levers to said controlling valve, a resaturating tank, an overflow connection between the first-mentioned tank and said resaturating tank, an overflow tank, an elevated tank, a pump for elevating the liquid from said overflow tank to said elevated tank, means for conducting the brine in said elevated tank to said valve, a gas-collecting pipe, and a series of vertical towers connected to said gas-collecting pipe, substantially as described.

814,878. ELECTRICAL MUSICAL INSTRUMENT; Melvin L. Severy, Arlington Heights, and George B. Sinclair, Winthrop, Mass. App. filed Nov. 24, 1900. In an electric means for vibrating sonorous bodies, the combination of a plurality of toothed members operating a plurality of sonorous bodies tuned to contiguous notes of the scale, brushes for said members, and means for producing relative motion between said members and brushes; one or more members having equally-spaced teeth throughout the greater part thereof, but not for the entire relative traverse of the member and its brush, substantially as described.

814,887. INSULATOR ATTACHMENT; Hans Swanson, Warren, Minn. App. filed Apr. 26, 1905. A cam lever is held in juxtaposition to the usual groove of the insulator by a binding wire. After this the cam lever is depressed so as to bear against the line wire within the insulator groove and hold it in place.

814,906. BOX FOR ELECTRIC MOLDINGS; John L. Gleason, Jamaica Plain, Mass. App. filed July 10, 1905. A box or fixture for use in making connections between wall and ceiling lines of molding. The box is shaped like a quadrant of a cylinder and has recesses for the entrance of the molding therein.

814,907. JUNCTION BOX FOR ELECTRIC WIRES IN BUILDINGS; John L. Gleason, Boston, Mass. App. filed July 12, 1905. In order to provide for the attachment of lamp fixtures in any position upon the wall moulding, the latter has discs with radially cut-away portions through which the wire and fastenings bolts may pass whatever the rotative relation of the parts to one another.

814,910. ELECTROMAGNETIC BRAKE; Erwin Kramer, Berlin, Germany. App. filed Aug. 3, 1904. The usual brake rigging is fitted with a solenoid magnet having an armature adapted to apply the brakes. This magnet is adapted to be placed in circuit with the motors of the train so that these generate a current and apply the brakes with a diminishing force as the velocity of the train diminishes.

814,913. RHEOSTAT; Edmund C. Morgan, Chicago, Ill. App. filed Dec. 5, 1904. A resistance element is formed by a pile of wire clippings or staples laid crosswise to one another and clamped in such relation by a bolt. The element thus formed has considerable resistance, and a very large radiating surface.

814,942. WIRELESS TELEPHONY; Archie F. Collins, New York City, N. Y. App. filed Aug. 21, 1905. In a wireless telephone or telegraph, the combination of a source of electromotive force, an arc lamp, a circuit with terminals connecting the same with the earth or other medium, a circuit including the arc lamp and containing a resistance, and a sound converter.

814,946. CONTROLLING DEVICE FOR MOTORS; Charles A. Dresser, Chicago, Ill. App. filed Sept. 12, 1903. An automatic starter for motors, comprising a solenoid acting on a core which is hollow and constitutes a dash pot. The core moves the switch arm over the contacts, and is held in raised relation by a detent which can be released by a magnet.

814,951. CAPACITY; Reginald A. Fessenden, Washington, D. C. App. filed Dec. 14, 1904. A condenser having in combination a dielectric and non-integral metallic coatings in electrical contact with one another and in continuous contact, except at such portions as the areas contact with each other with the dielectric.

814,981. ELECTRIC HEATING SYSTEM FOR CARS; Frank C. Newell, Wilkinsburg, Pa. App. filed Jan. 5, 1900. In order to make use of the train-starting resistances for heating purposes, the patentee arranges the starting resistances in corrugated iron boxes which are packed with an insulating substance capable of absorbing a considerable amount of heat so as to equalize the temperature fluctuations of the resistance element.

815,006. THERMAL PROTECTOR AND ALARM; Frank B. Cook, Chicago, Ill. App. filed Dec. 18, 1902. A combined lightning arrester and thermal cut-out in which the thermal cartridge not only serves to open the line circuit with respect to the switchboard, but at the same time grounds such circuit through an alarm bell.

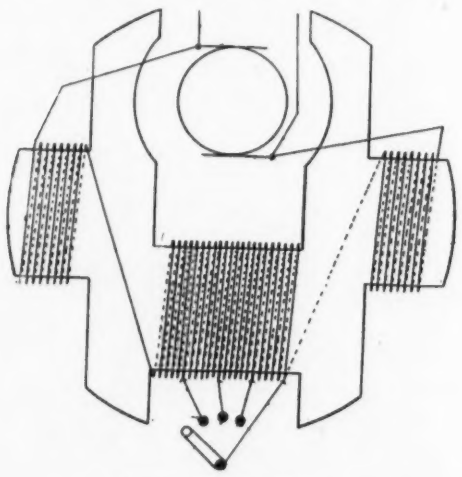
815,016. PROCESS OF SMELTING IRON ORE; Paul L. T. Heroult, La Praz, France. App. filed June 14, 1905. In the smelting of iron ore, the process which consists in feeding the ore, introducing carbon at the base of the charge while protecting it from the action of the carbon dioxide generated by the smelting operation, and introducing oxygen at a higher point to further oxide the carbon monoxide formed and increase the heating effect in the furnace.

815,025. MEANS FOR OPERATING THE ELECTRIC UNLOADERS OF AIR COMPRESSORS; Frederick Van D. Longacre, New York, N. Y. App. filed Nov. 20, 1903. A solenoid magnet is arranged to remove the load from the motor until it has arrived at a sufficient speed, corresponding to a predetermined notch of the starting resistance.

815,027. ELECTROPLATING APPARATUS; Guy L. Meaker, Chicago, Ill. App. filed Dec. 28, 1904. An electro-plating apparatus comprising a tank containing an electrolyte, a generator, an anode, a tray for supporting the articles to be plated, said tray having a bottom which constitutes the cathode terminal, and means for giving vibratory movement to said tray, the said bottom of the tray being of ridged or corrugated form.

815,042. TELEPHONE EXCHANGE; Benno Salzmann, Berlin, Germany. App. filed Nov. 16, 1905. Includes relays in a divided circuit, one of which responds to currents of ordinary strength and both of which respond to currents of an especially heavy character.

815,071. PRINTING PRESS ATTACHMENT; Clarence M. Dana and Edward Kibben, Grand Rapids, Mich. App. filed Feb. 20, 1904. The patentee secures to the delivery fly frame of a printing press a perforated pipe which constitutes a gas burner, so that the sheets in



814,740.—Electric Motor.

passing over the flame are partially dried, and the electricity thereof dissipated.

815,074. CIRCUIT-BREAKING APPARATUS; Frederick P. De Wilde, Chicago, Ill. App. filed Nov. 12, 1904. A form of cut-out for disconnecting one of a plurality of alternating-current generators in case its electro-motive force falls below a predetermined amount.

815,096. LAMP SOCKET LOCK; Julius C. Kircher, East St. Louis, Ill. App. filed Jan. 6, 1905. In order to avoid lamps being stolen, the usual threaded shell is substituted by a ratchet which permits the lamp to be screwed into its socket, but which renders ineffective any rotary motion of the lamp in a direction tending to unscrew it.

815,113. WET MAGNETIC ORE SEPARATOR; Francis J. Odling and William Jamieson, Melbourne, Victoria, Australia. App. filed May 19, 1904. The liquid current carrying the ore particles passes beneath a horizontally disposed V-shaped ledge which constitutes the magnetic pole of a powerfully energized electro magnet. A belt runs over the whole surface to carry away the particles adhering thereto.

815,131. ELECTRIC RAILWAY SIGNALING APPARATUS; James W. Tatum, Durham, N. C. App. filed June 2, 1905. Patentee provides a special trolley wire with which a circuit is made within the locomotive cab. This circuit is normally connected to indicate the presence of another train in the same block section. Connections are made by which the system can be used as a telephone circuit when desired.

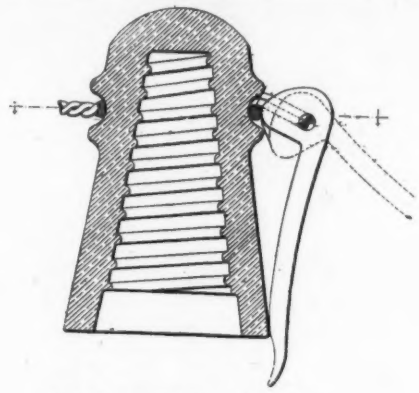
815,176. AUTOMATIC TELEPHONE CONNECTOR SWITCH; Alex. E. Keith, John Erickson and Charles J. Erickson, Chicago, Ill. App. filed Apr. 21, 1905. A connecter for automatic telephone systems, comprising switching contacts and means for operating the same, a locking device for preventing back movement of the switching contacts during their operation, a catch for normally holding the said locking device in an inoperative position, means for automatically disengaging said catch and releasing the locking device upon starting the operation of the directors and magnetically operated means for positively withdrawing said locking device and moving back into its normal position in engagement with said catch.

815,193. PRODUCTION OF AROMATIC ALCOHOLS; Carl Mettler, Munich, Germany. App. filed Oct. 11, 1905. The manufacture of aromatic alcohols by electrolytically reducing aromatic carboxylic acids, making use of a cathode of high cathodic tension.

815,221. ELECTRIC FURNACE; Marcus Ruthenburg, Lockport, N. Y. App. filed Aug. 14, 1905. In an electric furnace, the combination of a fused bath, of a layer of inert material floated on said bath, a layer of comminuted resister floated on said inert layer, and an electric circuit connected with said resister.

815,283. TROLLEY. Frank J. Gibbs, Tyrone, Pa. App. filed Jan. 20, 1905. The extremities of the trolley harp are bent outward so as to form a fork or prong to guide the wheel against the wire.

815,293. APPARATUS FOR SMELTING IRON ORE; Paul L. T. Heroult, La Praz, France. App. filed Sept. 7, 1905. A furnace for smelting iron and similar ores having provisions for introducing the ore at the top for the protection of the carbon from the carbon dioxide generated in the smelting operation, and provided also with means for supplying the necessary heat by means of the electric current, and having also provisions for introducing oxygen at a point above the point of formation of the carbon monoxide to convert the carbon



814,887.—Insulator Attachment.

monoxide rising through the charge into carbon dioxide and increase the heating effect in the furnace.

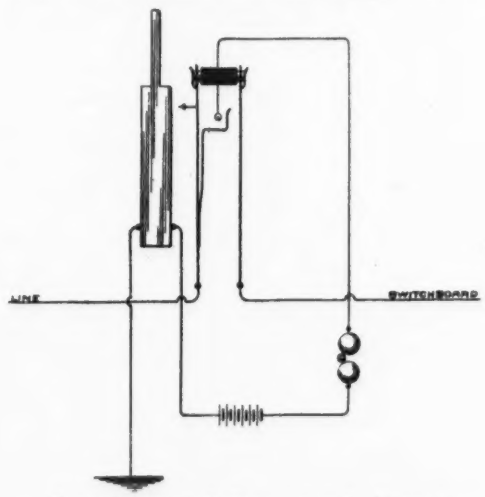
815,304. SYSTEM OF ELECTRIC MOTOR CONTROL; Charles A. Mudge, New York, N. Y. App. filed June 27, 1905. A master controller is provided with pilot circuits which energizes a pair of magnets in the head of a fluid cylinder which operates the power controller. The two magnets act on admission and release valves in the cylinder head so that the movements of the controller can be accurately governed.

815,314. RAILWAY SWITCH; Guy M. Thompson, Seattle, Wash. App. filed Aug. 3, 1905. The switch point has an extension which is directly acted upon by a pair of magnets beneath the track. These magnets are energized by the contact of tappets on the car with plates in the roadbed.

815,315. RAILWAY ELECTRIC SIGNALING APPARATUS; Benjamin F. Wooding, Denver, Col. App. filed Nov. 10, 1904. A pair of trolley wires are hung above the roadway by special forms of hangers which divide them into block sections. A pair of metallic sylinders are held on the car roof in an inverted V-form so as to contact with the special trolleys.

815,317. RESISTANCE DEVICE FOR ELECTRIC CURRENT CONTROLLERS; Lynde Bradley, Milwaukee, Wis. App. filed July 28, 1902. A resistance element composed of a pile of carbon discs contained in an asbestos tube which is in turn incased by a metallic jacket. The purpose is to prevent oxidation of the carbon in its heated state, by cutting off air supply, and preventing the escape of any carbon dioxide formed.

815,320. SAFEGUARD FOR AUTOMATIC RAILWAYS; Benjamin F. Carpenter, Roselle Park, N. J. App. filed May 12, 1904. Patentee provides a complete system for unloading subway trains on a branch track which does not interfere with the passage of cars on the main



815,006.—Thermal Protector and Alarm.

line. Specially locking switches are arranged to allow the exit of a train from the branch track until the main line is clear.

815,321. ATOMATIC TELEPHONE SELECTOR SWITCH; Alex Keith, John Erickson and Charles J. Erickson, Chicago, Ill. App. filed May 2, 1905. An automatic switching machine for telephone systems, comprising a plurality of banks of contacts, adjustable separating and holding devices between said banks, together with switch arms adapted to co-operate with said contacts in making connections, each bank being held in place and adjustable independently of the others.

815,322. ART OF TELEGRAPHY; Daniel M. Therrell, Charleston, S. C. App. filed Aug. 2, 1905. The step in the art of the electrical transmission and reproduction of sound which consists in making the terminal transmitter circuit or circuits wholly or partially resonant for the essential frequencies to be transmitted, thereby increasing the efficiency of transformation, and the energy transferred to the secondary circuit, substantially as set forth.